Food and Agriculture Organization of the United Nations

World Health Organization

CODEX ALIMENTARIUS
INTERNATIONAL FOOD STANDARDS

# USE AND IMPACT OF THE CODE OF PRACTICE FOR THE PREVENTION AND REDUCTION OF MYCOTOXIN CONTAMINATION IN CEREALS (CXC 51–2003) IN BRAZIL

## CASE STUDY REPORT

JOINT FAO/WHO
FOOD STANDARDS PROGRAMME

2025

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# ABBREVIATIONS

| | |
|---|---|
| **ANVISA** | Brazilian Health Regulatory Agency |
| **CAC** | Codex Alimentarius Commission |
| **CCAB** | Brazilian Codex Committee |
| **CCCF** | Codex Committee on Contaminants in Food |
| **CCEXEC** | Executive Committee of the Codex Alimentarius Commission |
| **CoP** | code of practice |
| **EMBRAPA** | Brazilian Agricultural Research Corporation |
| **EWG** | electronic working group |
| **FAO** | Food and Agriculture Organization of the United Nations |
| **FAOSTAT** | Food and Agriculture Organization Corporate Statistical Database |
| **GAP** | good agricultural practices |
| **GEMS/Food** | Global Environment Monitoring System/Food Contamination Monitoring and Assessment Programme |
| **GMP** | good manufacturing practices |
| **HACCP** | hazard analysis and critical control points |
| **HIC** | high–income country |
| **INMETRO** | National Institute of Metrology, Quality and Technology of Brazil |
| **ITAL** | Institute of Food Technology of Brazil |
| **JECFA** | Joint FAO/WHO Expert Committee on Food Additives |
| **LMIC** | low– and middle–income country[1] |
| **M&E** | monitoring and evaluation |
| **MAPA** | Ministry of Agriculture and Livestock of Brazil |
| **MLs** | maximum levels |
| **MMT** | million metric tonnes |
| **MRE** | Ministry of Foreign Affairs of Brazil |
| **µg/kg** | micrograms per kilogram |
| **ppm** | parts per million |
| **RCC** | Regional Coordinating Committee |
| **WHO** | World Health Organization |

[1] At the time of preparation of this report, LMIC was intended as "low- and middle-income country", not as "lower middle-income country"

# EXECUTIVE SUMMARY

Mycotoxins, produced by toxigenic fungi under certain environmental conditions, and found in soil, plants, crops and dust can lead to pre–harvest and post–harvest mycotoxin contamination in cereals, posing serious threats to human and animal health and trade. The Codex Alimentarius *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CoP) provides guidelines for preventing and reducing mycotoxin contamination in cereal grains, grain–derived foods and animal feeds. It emphasizes good agricultural and manufacturing practices considering environment and climate, as well as agronomic practices to enable and facilitate adoption of these practices.

Brazil successfully reduced fumonisin levels in maize by implementing the CoP, resulting in significant improvements in food safety and maize export quality and value. Brazil became the third–largest producer and second–largest exporter of maize worldwide. The case study claims that this was due to the establishment of national maximum levels (MLs) and the use of the CoP to support them.

While the case study set out to look at the use and impact of the CoP, the findings indicate a more complex picture. It was impossible to consider the use and impact of the CoP without looking at the wider enabling environment and the interactions between various elements. These included the understanding gained through the JECFA evaluations on fumonisins, in particular on the role of data that is geographically representative and reflective of the implementation of good practices in different environments. The need to share that data with the international community so that it can be taken into consideration in the development of Codex standards also became apparent. The establishment of MLs as a means of driving change which included implementation of the CoP was fundamental. Brazil's engagement in the Codex Committee on Contaminants in Foods (CCCF) and the leading role they took there taking into consideration the national challenges they were facing was also important. Discussions on Codex MLs and the CoP at CCCF, informed national discussions in Brazil as well as vice versa such that they contributed to the development of Brazil's approach to establish MLs as a regulatory tool and use the CoP to support implementation of the regulation, while in parallel contributed to the evolution of Codex texts.

This highlights the important synergism that exists between MLs and CoPs, and while they are not always developed in parallel in Codex for various reasons, this study suggests that when it comes to implementation there is value in using both MLs and CoPs together to decrease mycotoxin contamination. However, for this to be effective there needs to be widespread stakeholder engagement and multiagency support. The efforts in Brazil were successful because of that extensive engagement which ensured that regulatory efforts were supported by research, awareness raising, training and updated inspection protocols, to name but a few. Time was also a critical factor. Brazil did not expect to make changes overnight, rather the implementation of a progressive, phased approach, which allowed stakeholders to keep pace with a stepwise reduction in MLs helped ensure that producers and processors were not left behind.

These lessons learned may be valuable to other countries in their efforts to implement Codex standards.

# 1 INTRODUCTION

## 1.1 BACKGROUND

Toxigenic fungi under certain environmental conditions produce mycotoxins that pose a serious threat to both human and animal health, and are present in soil, plants, crops and dust which can be found in transport and drying and storage facilities for cereals and grains. The species and strains may differ among grain–producing regions. Irrespective of location, these can lead to pre–harvest and post–harvest mycotoxin contamination in cereals. The extent and severity of pre–harvest fungal growth can vary according to weather conditions and crop damage by other pests and therefore can be challenging to manage. Post–harvest fungal growth and mycotoxin production depend on factors such as temperature and humidity during storage, and management of environmental conditions and grain moisture levels are important aspects to control.

The Codex Alimentarius *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) (from now on CoP) provides relevant information for all countries to consider in their efforts to prevent and reduce mycotoxin contamination in cereal grains, grain–derived foods and animal feeds. In order for this CoP to be effective, it is necessary for national authorities, producers, marketers, and processors in each country to consider the general principles and examples of good agricultural practices (GAP) and good manufacturing practices (GMP) provided in the CoP, taking into account their local crops environment and climate, as well as agronomic practices to enable and facilitate adoption of these practices where relevant and feasible. The CoP applies to all cereal grains and cereal products relevant to human dietary intake and health as well as international trade.

Codes of practice are an important risk management tool that the Codex Committee on Contaminants in Foods (CCCF) develops when there is insufficient data to establish maximum levels (MLs) for contaminants, but there is nevertheless a need to reduce contamination levels so that the food is safe for human consumption. Codes of practice also play a key role in helping countries implement or enforce MLs when they exist, and the application of the GMP described in the codes of practice can lead to the progressive lowering of MLs over time.

The CCCF has encouraged Codex Members over the years to submit data based on GMP to the Global Environment Monitoring System/Food Contamination Monitoring and Assessment Programme (GEMS/Food) to facilitate harmonization of MLs and to increase geographical representativeness of the data available to support the establishment of international standards, guidelines and codes of practice. In this context, data generated and submitted by countries using codes of practice as the basis for risk management measures to reduce contamination play a key role in the establishment of MLs for contaminants.

Brazil is one of the countries that has successfully applied the CoP as part of its strategy to reduce mycotoxin contamination in cereals. The application of the CoP has also allowed Brazil to generate

occurrence data based on the GAP and GMP described in the CoP, hence facilitating adherence to the MLs associated with the mycotoxins and cereals addressed in the CoP. In particular, Brazil was successful in decreasing fumonisin levels in maize and was willing to collaborate and share its experience within CCCF. Brazil was therefore chosen as the subject of the case study with the aim of analysing the reasons for their success and extracting any lessons learned that could inform or support other countries in adopting similar approaches.

## 1.2 CASE STUDY OBJECTIVE AND SCOPE

A case study is an effective monitoring and evaluation (M&E) technique for understanding the use and impact of a Codex text, gathering qualitative data on implementation and the factors that contribute to its success or challenges. As part of its increased efforts to monitor and evaluate the use and impact Codex texts, the Codex Secretariat piloted a case study methodology to assess the use and impact of the CoP in Brazil. As this is the first Codex case study using this M&E methodology, it also serves as a proof of concept to test its potential for future case studies. Through this case study, dimensions as per the M&E framework will be assessed, with a focus on the text's reach, usefulness, and use (**Annex A**).

The aim of the case study was to:

a) develop an understanding of the collaborative efforts between the government and stakeholders in Brazil to reduce fumonisins contamination in maize by applying the knowledge gained through the participation in the CCCF and the application of the CoP;

b) collect evidence on the use of the CoP in the reduction of levels of fumonisins in maize and which factors are the cause of this;

c) identify key success factors, challenges, and lessons learned in this process that will feed into the Codex M&E framework;

d) make recommendations for sustaining and further enhancing the success achieved in reducing fumonisins contamination in Brazil and lessons learned that could be replicated by other Codex Members; and

e) make recommendations for the improvement of the CoP by CCCF.

## 1.3 METHODOLOGY

This case study pilot e mployed a mixed–methods approach to achieve comprehensive insights. The alignment of the case study pilot approach with the specific performance indicators for the Codex M&E framework for use and impact of Codex texts can be found at **Annex A**. The methodology included:

a) **Document review and data analysis:** A thorough examination was undertaken of existing literature, regulations, policies and data related to fumonisins contamination in maize in Brazil and its alignment with Codex texts. This also included information on changes to the country's food control system and/or infrastructure, the National Codex Committee process, training and information campaigns on food safety, and other such matters. A document list is found at **Annex B**.

b) **Stakeholder interviews and focus groups:** In–depth interviews and focus group discussions were conducted with key stakeholders, including government officials, agricultural experts, producers, industry representatives and research institutions. A detailed stakeholder interview list can be found at **Annex C**. This required on–site visits to maize production and processing facilities to conduct interviews and observe practices. The stakeholder interview guides can be found at **Annex D**.

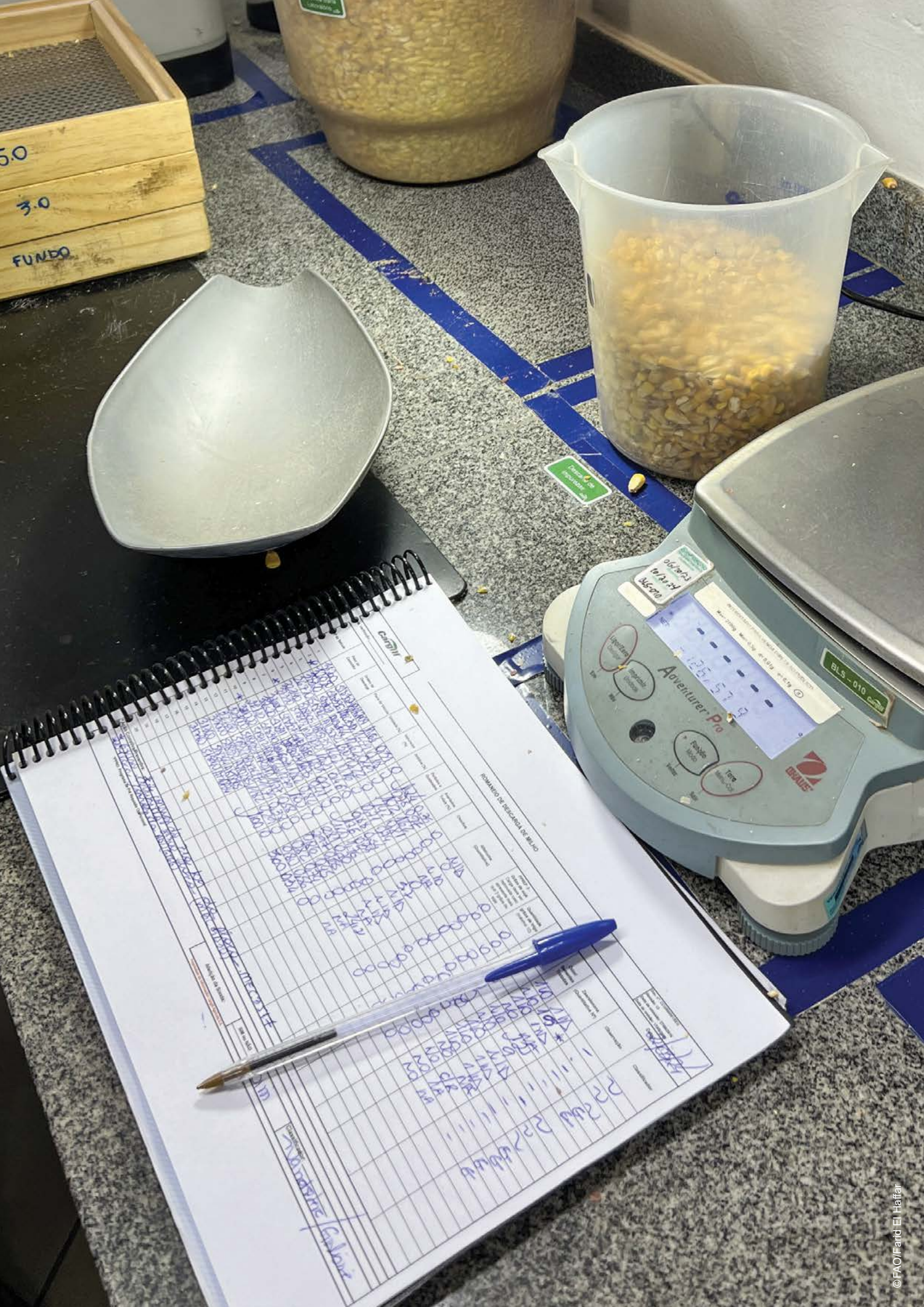
A one–week country mission was undertaken that aided with the collection of relevant documentation and facilitated the conduct of interviews and focus groups. The country mission programme for the case study team can be found at **Annex E**. A detailed list of Brazilian stakeholders that: (i) have been engaged with Codex; (ii) were familiar with Codex texts; and/or (iii) have been engaged in the issue of fumonisins contamination in maize in Brazil were confirmed with the Brazilian counterparts. Individual interviews took up to one hour and focus groups up to two hours.

The assessment of the CoP's use and impact in Brazil involved navigating an array of project challenges and limitations. Addressing these challenges and limitations required meticulous planning and active engagement with a wide range of stakeholders. The following highlight the case study limitations:

a) **Country documentation**: One of the primary challenges in assessing the impact of the CoP in Brazil was the limited availability of comprehensive documentation. Official records detailing the adoption, adaptation and enforcement of the CoP were incomplete, as there had been challenges in recording the processes during the period between 2011 and 2024. This limitation complicated efforts to fully understand the depth and consistency of integration of the CoP into national food safety protocols.

b) **Data availability and quality**: Data critical to evaluating the use and impact of the CoP was sometimes limited and of variable quality. Information on how the CoP has been implemented or enforced, and its impact on food safety, public health and trade varied across sources.

c) **Variability in implementation**: The CoP was adopted/adapted differently across Brazil's diverse administrative landscapes — from national to state or local levels. Additionally, the cultural, economic and social contexts within these regions can influence how standards are applied, potentially leading to a wide variety of enforcement and compliance levels. This reality posed a challenge with data gathering and analysis for this case study pilot.



# 2 CONTEXT

## 2.1 BRAZIL'S AGRICULTURAL LANDSCAPE

Brazil is the largest country in South America and the Latin American region. Worldwide, the country is the fifth largest in terms of land area (equivalent to 47 percent of South American territory) and population, with more than 212 million inhabitants. Brazil is a major agricultural and industrial power, and the strongest economy in Latin America and the Caribbean. It is a leading producer of maize, coffee, sugarcane, soybean, beef and poultry.[2]

Brazil has made considerable progress in reducing poverty from 64 percent in 1990 to 28 percent in 2021.[3] Despite this, Brazil remains a country of great contrasts. Inequality is highest in rural areas, especially in the semi–arid north–east.

Despite only representing 6.8 percent of Brazil's GDP, agriculture is important for income, employment and foreign exchange. Small–scale agriculture accounts for 77 percent of agricultural production and employs three quarters of the farm labour force.[4] However, most of the dynamism in the agriculture sector is created by corporate agriculture and driven by export commodities. Family farming is still characterized by low economic dynamism and a high incidence of poverty.[5]

## 2.2 BRAZILIAN MAIZE PRODUCTION

Maize is one of the most extensively cultivated crops worldwide, with its production concentrated in the United States, China and Brazil. These three countries collectively contributed to 64 percent of the world's total maize output, which reached 1 230 million metric tonnes (MMT) in 2023–2024.[i] The leading exporters are the United States, Brazil, Argentina, and Ukraine and during 2023–2024, these countries accounted for approximately 86 percent of global maize exports.[i]

A large portion of maize in Brazil is exported; in addition, this crop is consumed domestically, primarily for animal feed, food and, more recently, for bioethanol production.[ii] The production, domestic consumption and exports have more than doubled in the past 20 years, establishing Brazil as the third–largest producer and the second–largest exporter of maize worldwide, reaching a production of 109 420 717 tonnes in 2022 (see **Figure 1**).

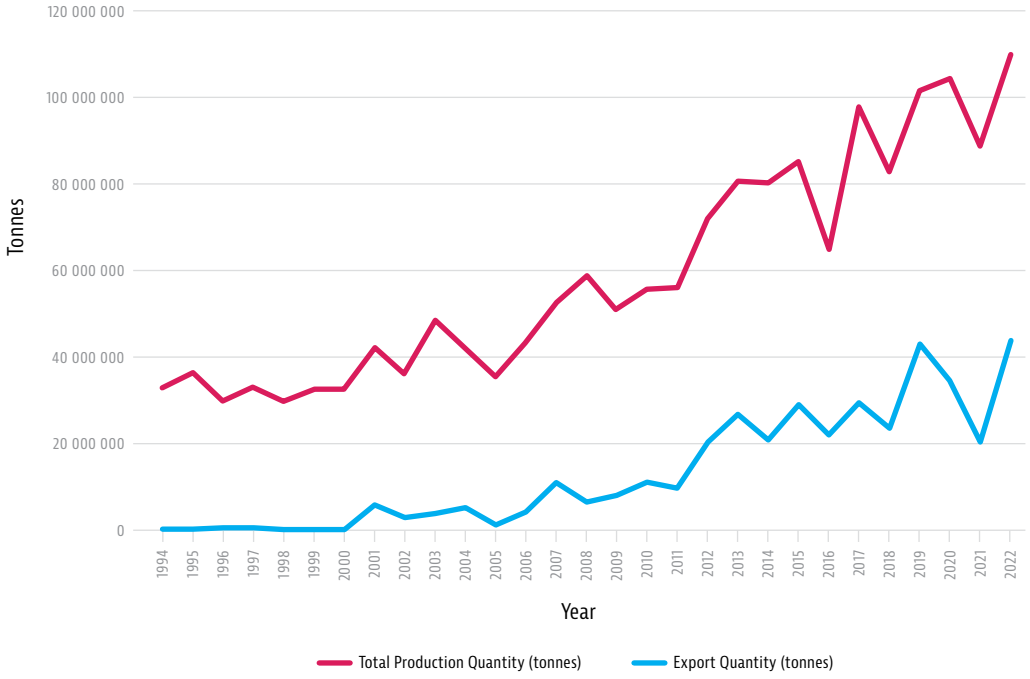
2 https://www.embrapa.br/en/busca-de-noticias/-/noticia/62619259/brazil-is-the-worlds-fourth-largest-grain-producer-and-top-beef-exporter-study-shows

3 https://data.worldbank.org/indicator/SI.POV.UMIC?locations=BR

4 https://biblioteca.ibge.gov.br/visualizacao/periodicos/3096/agro_2017_resultados_definitivos.pdf

5 https://www.ifad.org/en/web/operations/w/country/brazil

FIGURE 1 **Production and export quantities of Brazilian maize (1994 – 2022).**




Source: FAO. 2025. FAOSTAT: Crops and livestock products. [Accessed on 2 April 2025]. https://www.fao.org/faostat/en/#data/QC Licence: CC-BY-4.0.

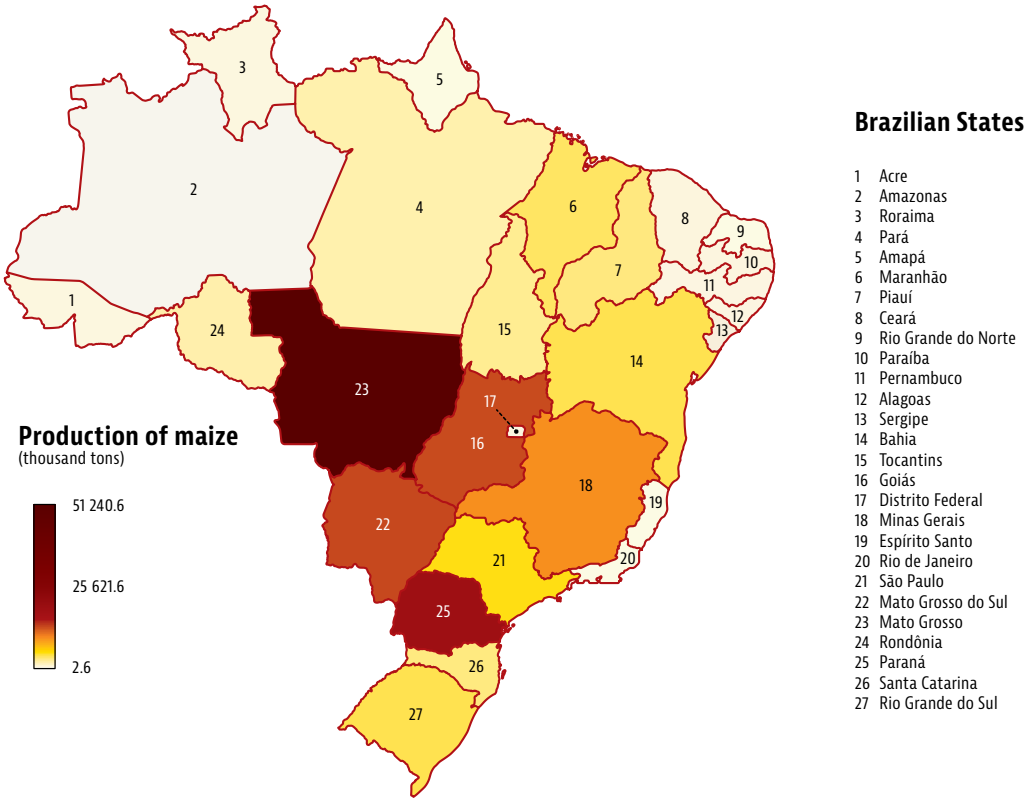
Although maize is cultivated across the country, the largest producing states are Mato Grosso, Paraná, Goiás, Mato Grosso do Sul, and Minas Gerais (located in the central west, south, and southeast regions of Brazil), contributing to 78 percent of national production (see **Figure 2**). These states are also responsible for most of the country's exports.

In contrast, in the north and northeast regions, small–scale farmers play a significant role in cultivating maize for subsistence purposes, indicating a growing significance of maize in both domestic and global contexts.[iii]

Given Brazil's vast land area and climatic conditions, maize is cultivated year–round, allowing three annual crop seasons. The second season was introduced in the 1980s and nowadays, it accounts for 77 percent of Brazil's production, while the first and third contribute 21 percent and 2 percent, respectively.[iv]

Brazil's first reports on fumonisin contamination of maize were published in 1991, primarily in samples intended for animal consumption.[v] Fumonisin levels fluctuated across the recorded years and these inconsistencies may be associated with climatic variations, farming practices, GAP and GMP, which may change fungal populations as well as mycotoxin occurrence and concentrations. Concerning levels were reported between 1991 and 2010, before ANVISA implemented MLs on fumonisins in food.

FIGURE 2 Map of Brazil indicating the states and major maize producers: Mato Grosso (23), Paraná (25), Goiás (16), Mato Grosso do Sul (22), and Minas Gerais (18). The production of maize by each state is designated in thousand tonnes.




Source: EMBRAPA (Brazilian Agricultural Research Corporation). 2024. Some data facts about (Brazilian) maize. [Slide deck]. Internal document.
Note: Refer to the disclaimer on page ii for the names and boundaries used in this map.

## 2.3 MAXIMUM LEVELS OF FUMONISINS IN MAIZE

The Codex ML for a contaminant in a food or feed commodity is the maximum concentration of that substance recommended by the Codex Alimentarius Commission (CAC) to be legally permitted in that commodity.[vi]

MLs for fumonisins in maize refer to the highest allowable concentration of fumonisins, which are mycotoxins produced by certain fungi, primarily *Fusarium* species, that can contaminate maize and other grains. Fumonisins are a concern because they can cause various health issues, including cancer, liver damage and neurotoxicity, particularly in livestock.

The MLs of fumonisins in maize are typically expressed in parts per million (ppm) or micrograms per kilogram (µg/kg) of maize. Regulatory authorities enforce these MLs through monitoring and testing programmes. If fumonisins levels in maize exceed the maximum allowable limits, regulatory actions may be taken, such as recalling contaminated products from the market or imposing penalties on producers or suppliers.

Occurrence data are needed to establish MLs for mycotoxins in food and feed. Regulatory authorities use scientific risk assessments that combine occurrence data, toxicological studies and exposure assessments to set these limits. Occurrence data help authorities assess mycotoxin prevalence in commodities and determine safe exposure levels. They are integral to risk assessments, enabling regulators to establish MLs that protect human and animal health by keeping exposure below harmful levels.

Within the CAC, the CCCF has the responsibility for establishing MLs for contaminants and naturally–occurring toxicants (which includes mycotoxins) in food and feed. In addition, the CCCF can elaborate related codes or practice. In line with the risk analysis principles which underpin the work of Codex, when the CCCF determines that new work is needed to make risk management recommendations for adoption by the CAC, it refers the substance to the Joint FAO/WHO expert Committee on Food Additives (JECFA). This committee is a risk assessment body which also has a mandate to address contaminants, requesting a risk assessment and/or the assessment of a range of risk management options or other pertinent questions. The report of the JECFA work provides the basis on which CCCF then makes its recommendations for adoption by CAC.

At the request of CCCF, JECFA conducted an initial risk assessment on fumonisins in maize, documented in the WHO Technical Report Series No. 906 (2001).[6] Based on this assessment, CCCF commenced discussions on establishing Codex MLs for fumonisins in maize. However, the process faced significant delays due to complex scientific, trade and risk management considerations, leading to an extended timeline. Different views among Member Countries on appropriate MLs and concerns over the sufficiency of data further prolonged the process.

The CCCF3 (2009) requested a re–evaluation by JECFA. A call for data to gather more geographically– representative information on fumonisin levels was issued and the JECFA re–evaluation undertaken in 2011.[7] Despite this re–assessment, no consensus was found on specific MLs, and discussions within the CCCF continued without resolution. During this period, Brazil played a proactive role by developing and presenting a detailed discussion paper based on JECFA's 2011 re–evaluation. This paper highlighted key scientific and regulatory considerations, contributing to CCCF's deliberations.

Although CCCF6 (2012) acknowledged the need to establish MLs for fumonisins, persistent differences on appropriate levels led to the suspension of the work on ML development. Instead, CCCF shifted its focus to exploring a possible revision of the CoP, including consideration of a specific code addressing fumonisin contamination. This shift further extended the timeline for establishing Codex MLs, reflecting the complexity and challenges involved in reaching international consensus on food safety standards.

Following further discussions at the subsequent two sessions of CCCF, MLs for fumonisins ($B_1$ and $B_2$) in raw maize grain and for maize flour and maize meal were established by CCCF and adopted by CAC in 2014. These are now included in the *General standard for contaminants and toxins in food and feed* (CXS 193–1995).[vi]

International standards, such as MLs rely on occurrence data from different regions to ensure global representativeness in the standards established. Additionally, regulatory authorities use occurrence data to monitor compliance with MLs, guiding enforcement actions which may include recalls or import bans and enabling adjustments to limits, when necessary, based on emerging risks or contamination changes.

6 https://iris.who.int/handle/10665/42448

7 https://apps.who.int/food–additives–contaminants–jecfa–database/Home/Chemical/2038

# 2.4 EVOLUTION OF THE CODE OF PRACTICE

The *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) was first adopted by the CAC in 2003. This included an annex specifically addressing fumonosins. Almost a decade later, the 6th Session of the CCCF (CCCF6, 2012) agreed to develop a discussion paper to identify any gaps in CXC 51–2003 and the need for a separate CoP for fumonisins in maize and whether there were any other measures to control fumonisins for this commodity. CCCF6 established an electronic working group led by Brazil to prepare this discussion paper.

At CCCF7 (2013), the delegation of Brazil, as chair of the electronic working group (EWG) on fumonisins in maize and maize products (established at CCCF6), informed CCCF7 that, in reviewing the CoP, it was found that "the Code mainly focused on primary production and that it would be useful to include effective GMP, such as sorting and cleaning to remove damaged kernels and other foreign matter at the industry level; that predictive models have also been proposed for the control of mycotoxins, including fumonisins and could be included in the CoP; that the CoP at the time of its adoption, included a section on hazard analysis and critical control points (HACCP) as a food safety management system in the future".

It was noted that the measures mentioned above were not necessarily specific for fumonisin and thus any revision would be to the existing CoP as the aspects to be addressed apply to all mycotoxins. It was also noted that a revision of the general section of the CoP could have an impact on the annexes, and that the annexes should therefore also be reviewed to ensure consistency with the main code.

CCCF7 agreed that it was too early to start new work on the revision of the code and that more information was needed on the nature of the revision. It was therefore agreed to re–establish the EWG, led by Brazil , to further develop the discussion paper and to prepare a proposal for the revision of the CoP for consideration by the next session of the committee.

The EWG made a recommendation for consideration by CCCF8 that there was a need to revise the CoP to include the knowledge gained in the last ten years on fungus–plant interaction and mycotoxin production. It was proposed that this revision should also include farmers and government experience in dealing with mycotoxin issues locally, as provided in the comments of the EWG.

CCCF8 (2014) agreed that new work on the revision of the CoP was timely in view of the newer technologies and practices available to prevent and reduce mycotoxin contamination in cereals. CCCF8 agreed to establish an EWG led by Brazil and co–chaired by United States of America and Nigeria to prepare a proposed draft revised CoP, including the integration of the annex on the prevention and reduction of aflatoxins and ochratoxin A (OTA) in sorghum.

Two years later, CAC39 (July 2016) adopted the revised *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CAC/RCP 51–2003); including annexes on zearalenone, fumonisins, ochratoxin A, trichothecenes and aflatoxins.

## 2.5 BRAZIL'S ENGAGEMENT WITH THE CODEX ALIMENTARIUS COMMISSION

To support Brazil's engagement in Codex work, the Brazilian Codex Committee (CCAB) was established in 1980.[8] It is led by the Brazilian National Institute of Metrology, Quality and Technology (INMETRO) and the Ministry of Foreign Affairs (MRE) and its members include:

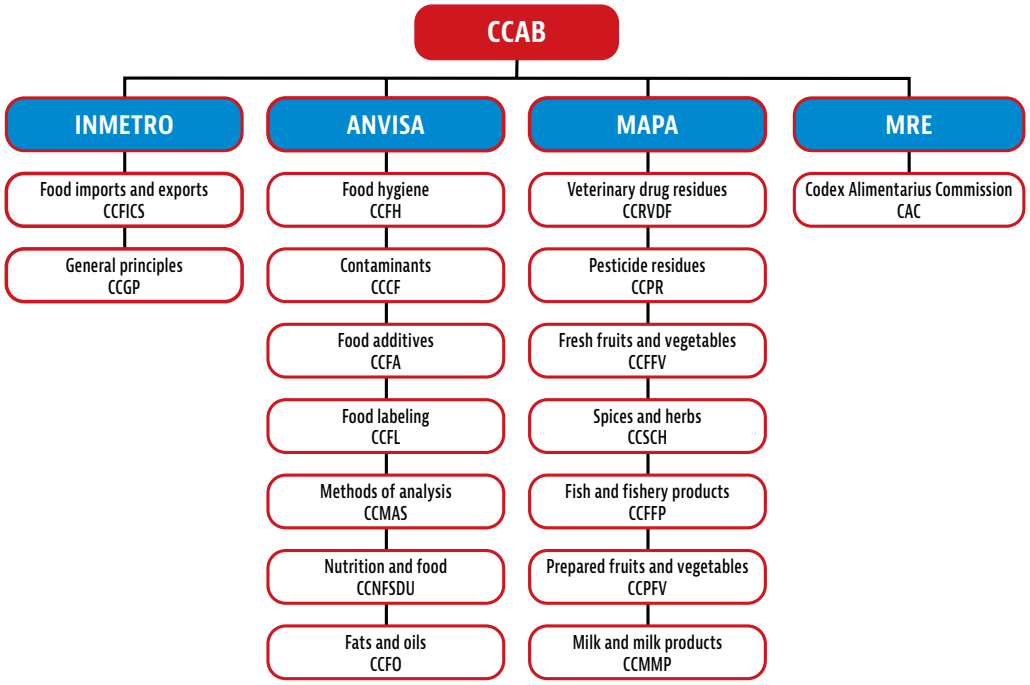
- Ministry of Foreign Affairs (MRE);
- Ministry of Agriculture and Livestock (MAPA);
- Brazilian Health Regulatory Agency (ANVISA);
- Ministry of Development, Industry, Trade and Services;
- Ministry of Science and Technology;
- National Institute of Metrology, Quality and Technology (INMETRO);
- Ministry of Justice;
- National Confederation of Industry;
- National Trade Confederation;
- National Confederation of Agriculture;
- Brazilian Association of Food Industries (ABIA);
- Brazilian Association of Technical Standards; and
- Consumer Protection Entities Indicated by The Consumer Representatives in The National Council for Metrology, Standardization and Industrial Quality (CONMETRO).

As outlined in **Figure 3**, the CCAB's structure mirrors the CAC structure. A subcommittee for contaminants in foods is led by the national authority for health regulations (ANVISA) with participation of different stakeholders, including MAPA, INMETRO, MRE, ABIA, consumer groups, private sector representatives, academia, research and extension institutes and others, depending on discussions held at CCCF and needs for specific expertise.

> *"This case study mission represents the first ever visit to Brazilian institutions by a member of the Codex Secretariat. Meeting Codex standards is very important to the Government of Brazil and we feel honoured and privileged to host this important initiative."*
>
> **Brazilian Government Official**

[8] CONMETRO Resolution – National Council of Metrology, Standardization, and Industrial Quality n 01 of 17 March 1980 and revised through CONMETRO Resolutions n 07 of 26 July 26, 1988, n 01 of 16 June 16, 1989, n 12 of 24 August 1992 and in 05 of 26 July 2993.

FIGURE 3 Brazilian National Codex Committee structure.




On 20 September 2019, the Federal Government of Brazil enacted Law No 13,874/2019 (the Brazilian Economic Freedom Act), which was passed with the aim of (i) reducing day–to–day bureaucracy for Brazilian investors; (ii) establishing free market guarantees; and (iii) providing greater legal certainty for Brazil's business environment. This law facilitates the use of Codex texts as reference points in instances where national regulations are absent or insufficiently detailed. It empowers the private sector to actively participate in regulatory discussions, allowing businesses to highlight areas where existing national standards may be outdated or not aligned with current international practices.

# 3
# CASE STUDY FINDINGS

The theory of change for the M&E framework to measure the use and impact of Codex texts is summarized in the Logic Model presented in **Annex A** and identifies five broad measurement areas (i.e. outputs, reach, usefulness, use, and contribution to intended long–term outcomes) that serve as the basis of performance planning, monitoring and reporting. Accordingly, the case study analysis is divided into four sections (i.e. reach, relevance, use and impact, and long–term outcomes) that align with the M&E framework Logic Model that was derived from the theory of change.

## 3.1 REACH OF THE COP IN BRAZIL

**Reach** covers an assessment of whether the "*target audiences have access to Codex texts*". It does this by assessing the dissemination strategies that countries put in place and the features of the Codex text.

### 3.1.1 DISSEMINATION

**Findings:** The National Codex Committee of Brazil collaborated closely with stakeholders to adapt the CoP to the national context, to meet national needs and be aligned with the objectives of the Brazilian Ministry of Agriculture and Livestock, supporting sustainable agricultural practices and increasing sector competitiveness. Other key stakeholders such as the Brazilian Ministry of Health, INMETRO and the Ministry of Industry helped adapting and disseminating the CoP.

**Analysis:** In 2012, CCCF6 initiated a review of the CoP, identifying gaps primarily concerning its focus on primary production. Brazil, chairing the EWG created for the review of the CoP, highlighted the need to extend the CoP to include GMP like sorting and cleaning at the industry level. Subsequently, the EWG recommended revising the CoP to incorporate recent insights on fungus–plant interactions and mycotoxin production, taking into account the past decade's advancements and local experiences from farmers and government feedback (further details on the revision of the CoP can be found in Section 2.4.)

Brazil's proactive participation at the CCCF and inclusive approach at national level, involving key national ministries, significantly strengthened the adaptation and implementation of the CoP within the country, also thanks to an effective National Codex Committee.

> *"The National Codex Committee is comprised of many stakeholders with the requisite technical knowledge. All committee members are knowledgeable."*
>
> **Brazilian Government Official**

### 3.1.2 INTENDED REACH AND DISTRIBUTION

**Findings**: The intended reach of the CoP is significant as it spans the entire production process, from planting to processing and is recognized for its importance by multiple stakeholders including producers, cooperatives, industry and indirectly – consumers. While well–integrated within companies, research institutions and universities – as it was also used to drive the progressive implementation of MLs in fumonisins[9] (see **Section 3.3**) – the reach of the CoP GAP and GMP among individual, and in particular, small–scale producers, remains limited.

**Analysis**: Key regulatory bodies, notably ANVISA and MAPA, have played a pivotal role in promoting the reach of the CoP, engaging with stakeholders to focus on reducing fumonisin levels in Brazil while adopting national MLs as an important regulatory tool. Additionally, industry associations like ABIA actively participate in national Codex discussions, on the establishment of national regulations and further national guidance based on the GAP and GMP contained in the CoP. Research organizations such as EMBRAPA and ITAL, that focus on capacity development and the generation of knowledge and technology for Brazilian agriculture, have supported the delivery of training to producers based on the CoP.

Despite these efforts, there remains a disparity in awareness and application of GAP and GMP between large and small producers in Brazil. While the industry and larger producers are generally well–informed through industry associations and adopt the CoPs practices, smaller rural producers exhibit a lower awareness of the specific guidelines (e.g. some producers indicated that when they see high contamination levels, they divert the production to animal feed, mixing it with sorghum to lower the contamination level). National regulations were found to be silent on the safety and efficacy of this mixing approach, while the CoP indicates it is important to minimize the mixing of the spoiled grain with the remaining portion of grain that appears to be in good condition. This highlights a noteworthy gap and underscores the need for targeted outreach and educational efforts to improve the uptake and application of recommended practices among smaller producers to ensure broader compliance and safety across the cereal production chain.

> *"We encourage companies to use the guides developed within the scope of Codex in addition to the application of national legislation, which is often constructed using CODEX documents as a reference."*
>
> **Brazilian Industry Association**

### 3.1.3 IMPACT OF MEDIA AND LANGUAGE CHALLENGES

**Findings**: Brazil, where Portuguese is the primary language, faced challenges in accessing the CoP. While members of the National Codex Committee in Brazil are proficient in English and capable of translating complex Codex documents for broader dissemination, there is a gap in direct accessibility for other stakeholders who may not be fluent in English or Spanish.

**Analysis**: The Brazilian dissemination strategy of the CoP GAP and GMP faced challenges due to technical language and complexities, suggesting a need for a more inclusive and varied media approach.

[9] Instrução Normativa – IN Nº 160, de 1º De Julho De 2022 (Publicada no DOU nº 126, de 6 de julho de 2022)/Normative Instruction – IN No. 160, of July 1, 2022 (Published in DOU nº 126, of July 6, 2022)

To address these issues, a more proactive approach by Lusophone countries in translating and adapting the CoP into Portuguese would be beneficial. Such an initiative would help bridge the language divide and ensure that all linguistic communities, especially small and local producers, can effectively access, understand and comply with the CoP. This would enhance food safety practices across Brazil by making critical information more accessible and actionable for a broader audience.

> *"We generally believe that employing a multifaceted media approach for disseminating the codes of practice can significantly enhance their effectiveness. One intriguing avenue to explore post–publication could involve the development of supplementary materials designed to simplify comprehension. This might entail the creation of visually engaging resources featuring figures, flowcharts, and condensed core information extracted from the document."*
>
> **Brazilian Government Official**

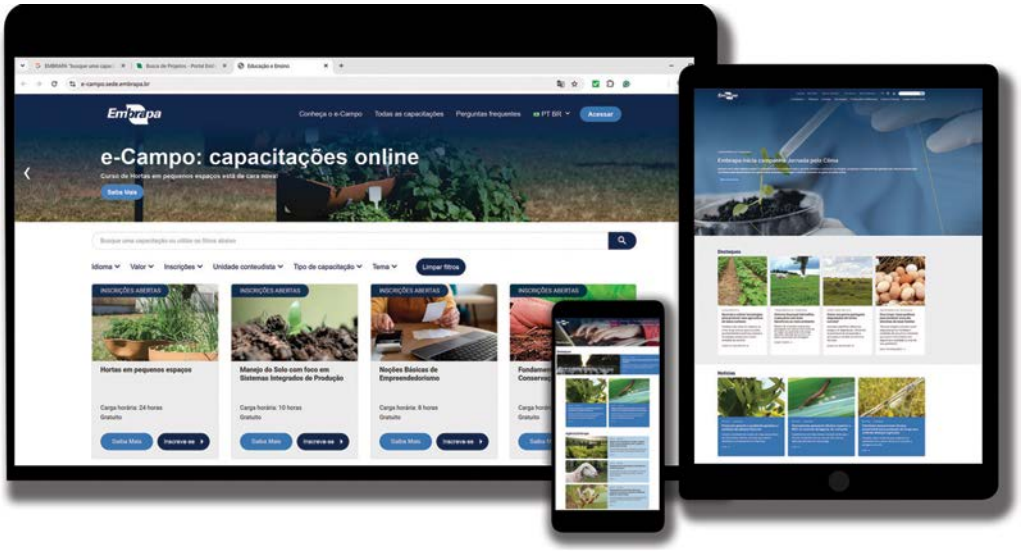
To enhance the effectiveness of these dissemination efforts, Brazilian stakeholders underlined the importance of visually–engaging materials such as infographics, flowcharts and figures that can simplify the technical content of the CoP. These visual aids make the information more accessible and understandable for a broader audience, including those with less technical background or limited English skills, and facilitate adaptation of the CoP to the local context.

Further improvements could include the creation of supplementary materials in Portuguese and employing simpler, layperson–friendly language. Increased engagement through various platforms such as television shows, social media, government–led workshops and webinars, alongside the traditional field days, could also help in reaching diverse demographic groups (See **Figure 4**).

> *"The Code of Practice boasts a well–structured format complemented by clear and concise language. Nevertheless, expanding the range of available document languages and creating supplementary materials would enhance accessibility and understanding."*
>
> **Brazilian Government Official**

> *"It can be hard for industry to find Codex material, which sometimes makes it to the facility level. Ideally Codex texts could be adapted to regional conditions, such as tropical microclimates."*
>
> **Brazilian Industry Association**

FIGURE 4 Sample educational actions.




©EMBRAPA

Moreover, integrating these practices into educational initiatives by universities, research institutions, and extension services could address the specific needs and capacities of diverse groups within the agricultural sector, ensuring more effective communication and application of the CoP.

While several of the needs identified above were addressed, the efforts to enhance the application and dissemination of the CoP in Brazil have involved collaborative initiatives between Brazilian authorities, researchers and the food industry. These efforts focus on making the CoP principles more accessible and understandable, particularly for small farmers in rural areas and diverse audiences across the vast country. Practical and user–friendly instructions have been developed, along with visually–engaging supplementary materials such as figures, flowcharts and condensed information extracted from the CoP. These resources are essential in facilitating a broader comprehension of the CoP.

### 3.1.4 STAKEHOLDER ENGAGEMENT

**Findings**: The legal framework in Brazil that requires public consultations for new regulations. This is to ensure transparency and public participation in the regulatory process. ANVISA, which is responsible for regulating food safety, conducted effective public consultations on proposed regulations to establish MLs for mycotoxins to gather input from various stakeholders, including consumers, industry representatives and other interested parties.

This participatory approach was designed to enhance the quality and acceptability of these regulations before they were finalized and enforced, and also provided an opportunity to share information on the CoP and its application which would be promoted as a means for stakeholders to improve practices in order to achieve the MLs (additional information on how the CoP was used can be found in Table 1 below).

**Analysis**: The dissemination and engagement strategies for national regulations (MLs for fumonisins), supported by the implementation and integration of the GAP and GMP contained in the CoP in national guidance and training, led to an increased involvement from key Brazilian sectors such as academia, regulatory bodies and the production industry. However, there have been notable gaps in reaching a broader audience effectively, particularly consumers and secondary stakeholders like academia, NGOs and the media.

Primary stakeholders, including government regulatory bodies, industry participants and consumers, were actively engaged in national Codex activities and technical discussions, including those related to fumonisin levels in maize. Yet, the technical nature of these discussions often precluded broader consumer participation, highlighting a clear need for materials that are accessible to non–technical audiences to foster better understanding and engagement.

On the other hand, secondary stakeholders, such as academia, face challenges due to a lack of awareness, and resource constraints that limit their ability to engage, especially in non–English speaking and rural areas. The engagement of Brazil's academic community could be enhanced to support the development and implementation of extension programmes.

> *"Industry has been consulted and the Code of Practice is applied in GMP/GAP. Our company is aligned to Codex, as corn is very important commodity to Brazil."*
>
> **Brazilian Industry Association**

To bridge these gaps and ensure more comprehensive engagement across all stakeholder groups, there is a need for more proactive strategies. These could include utilizing social media for wider reach, simplifying communications to make them more consumer–friendly, and incorporating the CoP, GAP and GMP into academic curricula to foster greater awareness and understanding. Additionally, improving feedback loops between primary and secondary stakeholders could further enhance the effectiveness of the engagement strategies, ensuring that all groups are better informed and more actively involved in discussions related to the CoP.

> *"In the academic setting, the grad schools are not familiar with Codex and it requires informed professors to teach them."*
>
> **Brazilian Academic Official**

# 3.2 RELEVANCE OF THE COP IN BRAZIL

**Relevance** looks at how well Codex texts meet the needs of their users and how they are viewed by Member Countries. For **stakeholder satisfaction**, the goal is to ensure Codex texts are useful and relevant to the specific needs of each Member Country and its stakeholders. For **recognition**, the aim is for Member Countries to see Codex texts as being authoritative, credible and timely.

## 3.2.1 STAKEHOLDER SATISFACTION

**Findings**: The CoP and the national guidance derived from it, were highly valued by a diverse range of stakeholders in Brazil, including government agencies, companies, farmers and researchers.

**Analysis**: According to stakeholders, the CoP significantly helped shape Brazilian agricultural GAP and GMP related to contaminants, particularly in aligning with international trade requirements to maintain market access. As a major producer and exporter of maize, Brazil benefits from adhering to the CoP GAP and GMP, which offer scientifically–supported guidelines to manage mycotoxin contamination effectively.

Brazilian government officials expressed their appreciation for Codex technical work, for its evidence–based practices, and its alignment to priority needs of Members.

Furthermore, the CoPs structured presentation of information has facilitated its use in training programmes and educational initiatives, thereby improving food safety and mycotoxin control. It has influenced legislative frameworks, like Brazil's Normative Instruction No. 60[10] on maize grain quality and has been integral to the development of a mycotoxin surveillance monitoring programme, fostering new research initiatives in the process.

Overall, the integration of the CoP into the national guidance/strategy to ensure that national maize producers would follow its GAP and GMP demonstrated its critical role in improving the quality and safety of Brazilian cereals. However, industry stakeholders have noted that there was room for enhancing the CoP to address specific farming techniques such as direct planting and crop rotation more comprehensively, which could further solidify its applicability and effectiveness in meeting Brazil's economic and health priorities.

> *"From a National Codex Committee perspective, Brazil is very satisfied with the Code of Practice and Committee members are using it. Without the Code of Practice, there would be no means to introduce new MLs. Time has passed, and it may be timely to start considering reviewing and potentially updating the Code of Practice."*
>
> **Brazilian Government Official**

### 3.2.2 PERCEPTION OF USEFULNESS

**Findings**: The CoP was judged as being well–structured and using clear, concise language, yet its practical application across different stakeholder groups in Brazil is hindered at times by language accessibility issues.

**Analysis**: While training and knowledge translation efforts at the state and regional levels – often supported by organizations like EMBRAPA – are crucial, their effectiveness varies. There is a recognized need for supplementary materials that are better adapted to the local linguistic and cultural context to enhance the CoPs practical application and effectiveness. Increasing the use of figures, photos, and real–life examples could also make the content more engaging and easier to understand for those unfamiliar with technical or English language content and would be supportive of existing outreach campaigns.

### 3.2.3 RECOGNITION AS AUTHORITATIVE, CREDIBLE AND TIMELY

**Findings**: The CoP was extensively regarded as a critical benchmark by regulatory authorities, lawmakers, academia and the agricultural industry. For industry in particular, the primary motivation for stakeholders in adhering to the CoP GAP and GMP was to prevent market losses associated with poor agricultural practices.

[10] Instrução Normativa 60/2011 (23/12/2011), Ministério da Agricultura, Pecuária e Abastecimento, Gabinete do Ministro.

**Analysis**: The credibility of the CoP was strongly supported by its adherence to scientific evidence. However, stakeholders have noted that what they consider to be a lengthy process to review the CoP by CCCF – (taking 2 years to agree on the focus of the new work and 3 years to complete the revision which is a usual timeline for Codex texts) – may have delayed its alignment with evolving scientific and industry developments. This delay potentially limited its effectiveness in addressing timely needs and integrating the latest scientific findings, such as conditions for the development of fumonisins and modified forms of mycotoxins.

> *"The Code of Practice is adopted as a standard in Brazil and as a result supports the national food control system through the surveillance oversight when applying the standard."*
>
> **UN Country Official**

Further, while the CoP has significantly contributed to the specificity and precision in addressing mycotoxin issues in cereals, there was a recognized need to tailor its recommendations to Brazil's unique needs. The national guidance adapting the CoP should focus on incorporating more detailed scientific information, especially those relevant to Brazil's specific agricultural conditions like soil management and dual cropping cycles in a tropical context. Research has shown that Brazil's southern states presented higher risks of occurrence and concentration levels of fumonisins in corn due to the temperate climate with lower average temperature and higher relative humidity and precipitation indices.

The generated monitoring data were important for regulatory agencies and the agricultural sector, which needed to be aware that the chance of success in grain production depends on efficient planning of the growing season, concerning the climatic conditions to which it is subject to minimize the risks.[vii]

> *"Codex texts are used as references by industry in Brazil. They are viewed as credible and science based."*
>
> **Brazilian Industry Official**

## 3.3 USE OF THE COP IN BRAZIL

**Use** is related to the use of knowledge gained by target stakeholders from Codex texts. From the use of Codex texts in these varied areas, the theory of change presumes that in the long term, there will be improved consumer health protection at the individual and community levels and fair practices in the food trade.

The application of knowledge gained from Codex texts by stakeholders entails the adaptation at national level of Codex texts to:

1. support the development and/or implementation of new or enhanced food safety and quality policies, legislation/regulations, guidelines, programmes, and practices;
2. support national food control systems;

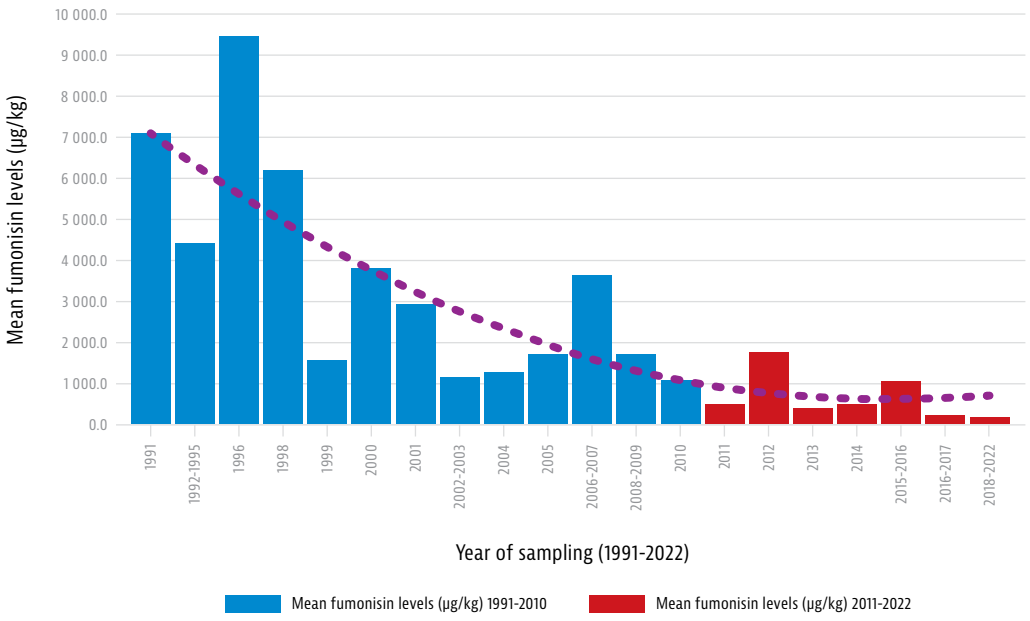
3. increase stakeholder awareness of food safety and quality issues and evidence–based interventions and recommendations;
4. inform and are used to update food safety and quality training and educational programmes and related tools; and
5. improve Member State commodity trade (internal and exports).

### 3.3.1 DEVELOPMENT AND/OR IMPLEMENTATION OF NEW OR ENHANCED FOOD SAFETY AND QUALITY POLICIES, LEGISLATION/ REGULATIONS, GUIDELINES, PROGRAMMES AND PRACTICES IN BRAZIL

**Findings**: The CoP has significantly influenced food safety policies, legislation and agricultural practices in Brazil, particularly concerning the regulation of mycotoxins in the food chain (please also see **Table 1** below). The adoption of national MLs in mycotoxins in maize facilitated the implementation of the CoP.

**Analysis**: Brazil's first reports on fumonisin contamination were published in 1991, primarily in samples intended for animal consumption. **Figure 5** highlights concerning levels of fumonisins that were reported between 1991 and 2010, prior to implementation of MLs on fumonisins in food.

FIGURE 5 Mean fumonisin levels (µg/kg) in Brazilian maize and its by–products from 1991 to 2022.




Source: Rocha, L.O., Taniwak, M.H., Ennis, M., Lindner Schreiner, L.. and El Haffar, F. 2024. Reducing fumonisin contamination in Brazilian maize: The impact of Codex standards and regulatory frameworks. In: *Food Research International*, Vol. 197, Part 2. [Accessed on 2 April 2025]. https://doi.org/10.1016/j.foodres.2024.115280.

Recognizing the risks to public health, the government initiated a collaborative effort with producers to reduce the level of fumonisins. The Codex delegation of Brazil, as part of the national efforts to address fumonisins in maize, increased its participation and contribution to CCCF, in particular in reviewing and updating the CoP and in discussions on the establishment of the Codex MLs.

## ANVISA's leadership in establishing MLs for mycotoxins

In 2004, the then head of the national subcommittee on contaminants in food started attending CCCF as head of the Brazilian delegation. ANVISA began to gain knowledge on the risk assessment process that led to the establishment of MLs of contaminants. In particular, how the submission of country occurrence data on contaminants in food to the GEMS/Food Global database on contaminants in food was used by JECFA to conduct a risk assessment to recommend MLs, which in turn was used as scientific advice by CCCF to establish MLs.[viii]

CCCF had expressed its concern that Members were not contributing data on mycotoxin contamination levels of cereals, and considered the application of the CoP as a tool to allow countries to undertake a virtuous path that would allow them to decrease mycotoxin contamination in cereals and increase Members' confidence in the submission of data. In particular, submission of mycotoxin occurrence data by low– and middle–income countries (LMICs) could be difficult due to the high investment costs associated with extensive surveillance and required laboratory infrastructure. Consequently, high–income countries (HICs) submitted more data than LMICs, therefore possibly creating a bias in the risk assessment process towards HICs conditions.[11]

Through the submission of Brazilian data to GEMS/Food, higher contamination levels of fumonisins in maize were being considered in the JECFA risk assessment process, therefore contributing to establishing MLs that were more in line with the situation in LMICs. ANVISA had realized, with the national ML data available at the time, that approximately 90 percent of collected samples had a higher contamination level in maize than those allowed, for instance, in the European Union for human consumption. This affected not only the safety of food and health of consumers, but also export, due to high rejection rates by importers.

These three processes were seen as intimately related and mutually supporting. This was reported and discussed at the national subcommittee level with the different stakeholders involved. While general agreement was expressed with this approach, resistances were met, in particular regarding the publication of official data on contamination in maize.

ANVISA proposed a **three–pronged approach** to tackle the issue of establishing national MLs:

1. Start collecting **occurrence data** officially at national level on levels of contamination;
2. Adopt a **phased approach to establishing national MLs** on fumonisins in maize; and
3. **Assist producers** to lower fumonisin levels in maize to meet the established MLs, by enhancing capacities in good agricultural practices (GAP) and good manufacturing practices (GMP), using the CoP as a basis.

[11] This assertion is based on observed trends in data submission where HICs are noted to contribute more significantly to the global data pool compared to LMICs. This disparity likely introduces a bias towards the conditions and standards prevalent in HICs, potentially impacting the universality and applicability of risk assessments. Further studies are needed to explore how this imbalance affects risk assessment outcomes globally.

As a consequence, a national dialogue was started, with ANVISA participating in meetings, congresses and events related to maize production and/or mycotoxin contamination in Brazil, to explain the importance of the risk assessment process and risk communication.

For instance, several Brazilian institutions organized regular national meetings on mycotoxins in which ANVISA participated from 2008. During the 2009–2011 period, ANVISA participated in an average of five national events per year.

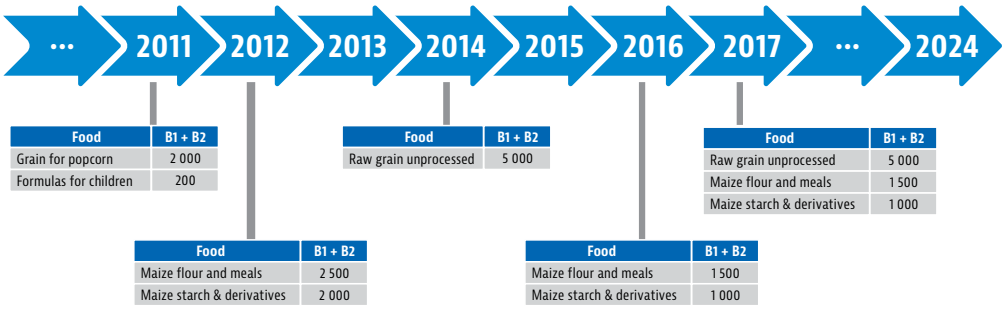
> *"Brazil has a "culture of dialogue". It recognizes the importance of engaging with many diverse stakeholders. Politics are not hindering good science from doing its work."*
>
> **Brazilian Government Official**

## Establishment of MLs in Brazil

As mandated by Brazilian law, ANVISA issued a public consultation in 2009, two years before the regulation on the proposed national MLs was issued in 2011, to which stakeholders could send comments and/or concerns. In 2009, the proposed MLs were based on the EU regulation which had much lower limits, as no national reliable data was available. Proposing extremely low MLs was also part of a negotiation strategy. This triggered concerns across producers who subsequently started submitting data to demonstrate that the proposed MLs were not applicable in Brazil. During the consultation process, criticism and opposition was received from several stakeholders. ANVISA replied formally to all comments received, indicating if they were accepted or rejected and providing a justification. The results of the final consultation were published.

For ANVISA, the decision to establish MLs initiated and promoted the process of data submission and GAP and GMP application based on the CoP, as per the legislation timeline shown in **Figure 6**.

FIGURE 6 **Timeline of establishment of MLs for mycotoxins in maize in Brazil.**




Source: EMBRAPA (Brazilian Agricultural Research Corporation). 2024. Some data facts about (Brazilian) maize. [Slide deck]. Internal document.
Note: All quantities in µg/kg

When issuing the regulation in 2011, ANVISA, in collaboration with the other members of the national Codex subcommittee, decided to adopt a phased MLs adoption approach, gradually lowering the MLs over time. Dispositions (Resolution N.7 [February 2011]) for MLs of mycotoxins in food established MLs for fumonisins in maize adopted the following timelines for MLs:

- in January 2012: maize flour (2 500 µg/kg);
- in January 2014: maize in grains for further processing (5 000 µg/kg);[12] and
- in January 2017: maize in grains stays the same, but maize flour reduced to 1 500 µg/kg.

Today, ANVISA conducts regulatory impact assessments, based on the risk assessment, before making a proposal to establish a ML. The current normative instruction in Brazil (No. 160, of July 1, 2022 (published in DOU Nº 126, of July 6, 2022) establishes the maximum tolerated limits of contaminants in food, including for mycotoxins. Presently, ANVISA is collaborating with authorities to revise the legislation to align with the Codex MLs, specifically the MLs for maize in grains for further processing from 5 000 µg/kg to 4 000 µg/kg.

## Current regulatory environment for fumonisins in Brazil

This CoP has been instrumental in achieving regulatory benchmarks in Brazil and has also prompted agricultural producers to adopt more stringent practices and enhanced monitoring of mycotoxin levels, which have become mandatory. Regulatory bodies such as ANVISA and MAPA have adapted the GAP and GMP provided by the CoP and integrated them in inspection protocols and quality standards, ensuring compliance with both national and international safety standards. Furthermore, the Code has been integrated into training programmes aimed at upgrading food safety measures.

**Table 1** demonstrates that the CoP served as a foundational document in Brazil's regulatory framework. The table summarizes the roles and impacts of various Brazilian stakeholders who have effectively utilized the CoP to reduce mycotoxin contamination in cereals, particularly maize. This comprehensive impact underscored the CoP's use as a reference point in continually advancing Brazil's food safety landscape.

[12] This Brazilian ML was aligned to the CCCF previously proposed but not adopted level of 5 000 µg/kg fumonisins. At CCCF8, in February 2014, the Committee agreed on revising the proposed maximum levels to 4 000 µg/kg for raw cereal grains, which was approved by CAC37 in July 2014.

TABLE 1 Brazilian stakeholders who have made use of the Code of practice for the prevention and reduction of mycotoxin contamination in cereals and related activities/actions.

| STAKEHOLDER | USE OF COP AND RELATED ACTIONS |
|---|---|
| **ANVISA (Brazilian Health Regulatory Agency)** | ◆ led the adoption of MLs for fumonisins based on the CoP;<br>◆ integrated CoP GAP and GMP into national strategy for the implementation of the MLs; and<br>◆ led national consultations. |
| **MAPA (Ministry of Agriculture and Livestock)** | ◆ incorporated the CoP recommendations into agricultural inspection protocols;<br>◆ monitored compliance with fumonisin MLs; and<br>◆ supported training programmes on GAP and GMP. |
| **INMETRO (National Institute of Metrology)** | ◆ facilitated national alignment with Codex MLs and CoP; and<br>◆ promoted stakeholder engagement. |
| **EMBRAPA (Brazilian Agricultural Research Corporation)** | ◆ researched resistant maize cultivars;<br>◆ developed and promoted GAP using the CoP as a basis; and<br>◆ conducted field trials and educational programmes on mycotoxin management that informed the adaptation of the CoP to the local context. |
| **ITAL (Institute of Food Technology)** | ◆ investigated mycotoxin contamination in maize and by–products;<br>◆ supported data collection for risk assessments; and<br>◆ participated in CCCF discussions together with ANVISA and contributed to the overall understanding of the risk assessment process. |
| **UNICAMP (University of Campinas)** | ◆ conducted long–term studies on fumonisin levels in maize;<br>◆ analysed impact of CoP implementation on fumonisin levels; and<br>◆ provided critical data for regulatory decisions. |
| **IAC (Agronomical Institute of Campinas)** | ◆ focused on breeding maize cultivars resistant to fumonisin–producing fungi; and<br>◆ provided guidance on agronomic best practices. |
| **ABIA (Brazilian Association of Food Industries)** | ◆ promoted CoP–aligned GMP among food processors;<br>◆ engaged in National Codex Committee; and<br>◆ advocated for food safety standards. |
| **Large–scale maize producers** | ◆ implemented CoP including GAP and GMP to meet fumonisin MLs; and<br>◆ invested in resistant maize varieties and post–harvest control measures. |
| **Small–scale farmers** | ◆ participated in training programmes based on the CoP GAP and GMP; and<br>◆ integrated CoP practices into production to a certain extent. |
| **Consumer protection entities** | ◆ participated in public consultations on food safety (MLs) regulations; and<br>◆ advocated for stricter mycotoxin standards and transparency. |

### 3.3.2 SUPPORT TO NATIONAL FOOD CONTROL SYSTEM OF BRAZIL

**Findings**: The adoption of MLs in mycotoxins in maize played a critical role in harmonizing the approach to address food safety of cereals within Brazil's national food control system, particularly within the cereals sector. The GAP and GMP of the CoP have become a key reference across various regulatory bodies, including federal, state, and municipal levels, integrated in inspection protocols and quality control measures throughout the country.

**Analysis**: One significant impact of the CoP integration has been the monitoring of critical factors such as grain humidity in cereals, which is essential for maintaining the quality and safety of cereals, reducing the risk of mycotoxin contamination, and ensuring that products meet both national and international standards. While product inspection occurs primarily at the consumer level, with finished products, the post–harvest assessments of mycotoxins is self–tested by the industry. Collectively, this monitoring approach in Brazil led to a noticeable decrease in mycotoxin contamination levels in cereals.

> *"There has been a high–level of adoption of the Code of Practice in industry. Greater awareness as the appearance of contaminants can cause food safety concerns that can impact profitability."*
>
> **Brazilian Research Official**

However, it was noted that the inspection system at the municipal/state level were not at the same level as for the national level in Brazil, these inspection differences presented ongoing challenges for Brazilian regulators and posed risks to public health.

The existence of informal markets and variable compliance levels underscores the need for continued enforcement and education efforts to ensure widespread adherence to safety standards.

### 3.3.3 STAKEHOLDER AWARENESS OF FOOD SAFETY AND QUALITY ISSUES AND EVIDENCE–BASED INTERVENTIONS AND RECOMMENDATIONS IN BRAZIL

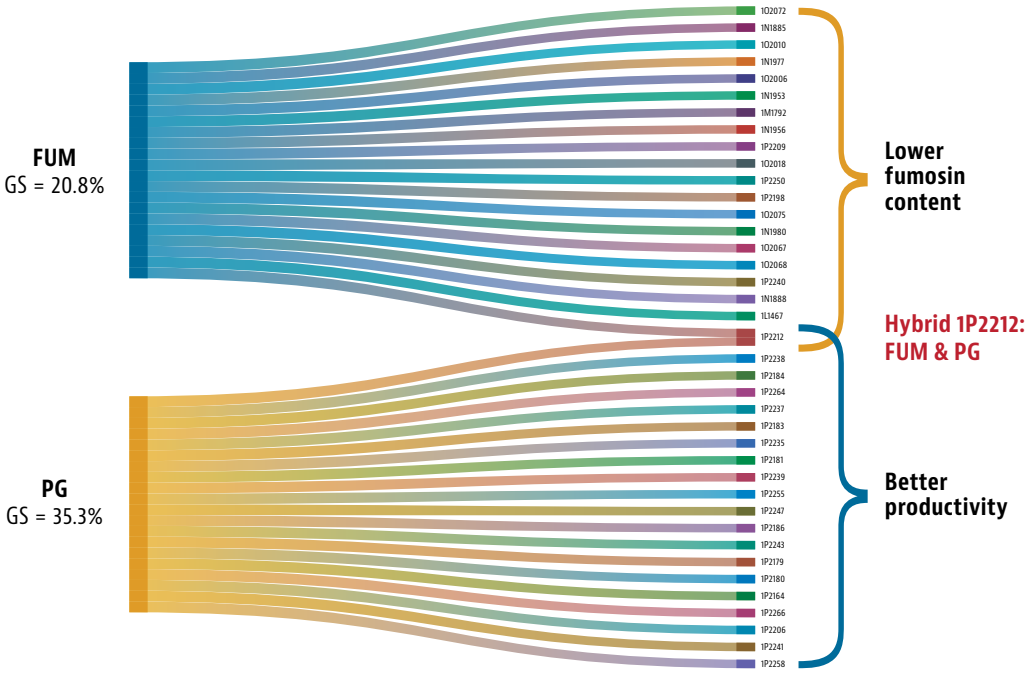
**Findings**: The dissemination approach for the CoP in Brazil has resulted in raised awareness and improved practices related to food safety and quality, particularly concerning mycotoxin management in the cereals sector. This increased awareness can be primarily attributed to proactive engagement in National Codex Committee discussions, which allowed a diverse range of stakeholders to understand and address food safety needs specific to mycotoxins. The promotion of the CoP, to support the implementation of the Brazilian regulations on MLs for mycotoxins in food established in 2011, has further heightened this awareness and led to more rigorous food safety and quality practices across the industry.

**Analysis**: Stakeholders, including key industry players and regulatory bodies, have shown a high level of awareness of the CoP GAP and GMP, evidenced by positive inspection results and the outcomes of monitoring programmes targeting mycotoxin contamination. The active application of the CoP has been witnessed in the large–scale maize production and processing sectors, where adherence to mycotoxin monitoring and compliance with national MLs are critical, not only for maintaining domestic market standards but also for ensuring the quality of exports, particularly in products used predominantly for animal feed.

Moreover, the engagement in training programmes on HACCP and initiatives by associations to incentivize the production of crops such as wheat and maize in accordance with mycotoxin MLs, reflect a broad and effective stakeholder involvement. These efforts are promoting better agricultural practices and enhancing the food safety culture across Brazil, thus illustrating a comprehensive and effective integration of the CoP into national food safety strategies.

Additionally, ANVISA also decided to start national calls for occurrence data, using the same tables used by GEMS/Food, translating them into Portuguese and issuing calls for data. This helped Brazil in its own assessments of contaminants in food and facilitated submissions to GEMS/Food when calls for data were issued. ANVISA also reached out to research organizations, such as the Brazilian Agricultural Research Corporation (EMBRAPA) and the Institute of Food Technology (ITAL), to undertake research into more resistant varieties of maize (see **Figure 7**). It also started advocating for GAP and GMP in several fora, as the main means to lower fumonisins contamination.

FIGURE 7 **Research into crop breeding for lower fumonisin content and better productivity.**




Source: EMBRAPA (Brazilian Agricultural Research Corporation). 2023. *Circular Técnica 284, EMBRAPA Maize & Sorghum*.

Initially, calls for occurrence data were met with resistance by producers, with initial data submitted showing much higher contamination levels than what was being assessed by the national laboratories.

Meetings were held to explain the risk assessment process and the need for better quality and reliable data. The involvement of producers since the initial stages of the work to establish MLs within the national regulations, helped in the adoption and spread of the good practices (GAP and GMP) as well as submission of reliable data.

### 3.3.4 UPDATED FOOD SAFETY AND QUALITY TRAINING AND EDUCATIONAL PROGRAMMES AND RELATED TOOLS IN BRAZIL

**Findings**: The CoP has had a significant impact on the educational landscape in Brazil, particularly on food safety and quality training.

**Analysis**: Academia, including universities, research institutes and educational institutions, have been actively involved in discussions related to the adoption and subsequent adaptation of the CoP to meet the country's need. These discussions have facilitated the integration of elements of the CoP into various university courses such as: pharmaceutical sciences, veterinary medicine, food science, food engineering and chemistry. Professors incorporate the CoP into both undergraduate and postgraduate classes, and extension courses often led by researchers provide practical applications of CXC 51–2003.

> *"I have seen the Code some showcased in seminars, workshops and informal meetings, such as field days, to transfer the information on good practice in planting, pre–harvest, harvest, drying, transport, storage, manufacturing, etc. This has involved public authorities, producers, cooperatives, industry, and academia."*
>
> **Brazilian Academia Official**

Institutions like EMBRAPA have been instrumental in disseminating guidance materials and conducting seminars, workshops and informal meetings such as field days, based on the CoP. These initiatives helped transfer knowledge about GAP across the entire production chain – from planting to manufacturing – among public authorities, producers, cooperatives, industry and academia.

Additionally, MAPA's Department of Plant Inspection has aligned its inspector training programmes with the GAP and GMP outlined in the CoP, enhancing the standardization and effectiveness of inspections across the country.

Workshops, webinars, and e–learning platforms have been integral in promoting ongoing education and training for all stakeholders, including the use of social media, websites and technical publications to reach consumers more effectively. As an example, EMBRAPA officials have identified opportunities for enhanced training and dissemination efforts with stakeholders in the grain and animal protein chains. However, despite the effectiveness of current dissemination methods, there is a recognized need for further enhancement, especially in rural and remote areas. Leveraging technical assistance, rural extension services, and incorporating the CoP into academic and research discussions are seen as key strategies to ensure comprehensive understanding and implementation.

Despite these advances, there remain challenges in fully integrating the principles contained in the CoP into university curricula across Brazil, with academic programmes sometimes slow to update and incorporate new regulatory information and related programmes and strategies. The engagement with students and broader audiences, particularly rural producers, could be improved through better use of digital platforms such as webinars.

### 3.3.5 IMPROVED COMMODITY TRADE (INTERNAL AND EXPORTS)

**Findings**: The adoption of MLs in mycotoxins in maize, supported by the adoption/adaptation of the CoP at national level, has had a notable positive impact on Brazil's maize trade, both domestically and internationally.

**Analysis**: The introduction of the regulation establishing MLs for mycotoxins in 2011, supported by the CoP, have contributed to enhanced product quality and reduced contamination levels, leading to lower rejection rates at international borders and facilitating access to new markets. **Figure 8** highlights significant improvements in maize production and export volumes.

FIGURE 8 **Production and export quantities of Brazilian maize (1994 – 2022).**


Source: FAO. 2025. FAOSTAT: Crops and livestock products. [Accessed on 2 April 2025]. https://www.fao.org/faostat/en/#data/QC
Licence: CC-BY-4.0.

Stakeholders suggest that further academic studies could provide a clearer demonstration of how the implementation of the of MLs in mycotoxins, supported by the CoP has affected trade trends. Additionally, industry officials recognize the influence that Codex texts (and this CoP) have on regional trade harmonization, where Codex texts serve as a benchmark supporting safe trade practices. Further, Brazil's proactive efforts in adopting Codex–aligned food safety standards and advocating for fair MLs in MERCOSUR trade agreements demonstrate its strong regional commitment to food safety leadership.[13]

[13] Food standards and Codex Alimentarius in the context of MERCOSUR (https://www.fao.org/4/v9723t/v9723t0c.htm).

# 3.4 IMPACT ON PROTECTION OF CONSUMER HEALTH AND ENSURING FAIR PRACTICES IN THE FOOD TRADE

The **long–term outcomes** in the M&E framework refer to the ultimate, enduring changes or impacts that result from Brazil's Codex activities, often happening years after the activities have been implemented. The result statement for **use and impact** relates to the use of knowledge gained by target stakeholders from Codex texts. From the use of Codex texts in these varied areas, the theory of change presumes that in the long term, there will be improved consumer health protection at the individual and community levels and fair practices in the food trade.

## 3.4.1 IMPACT ON PROTECTION OF CONSUMER HEALTH

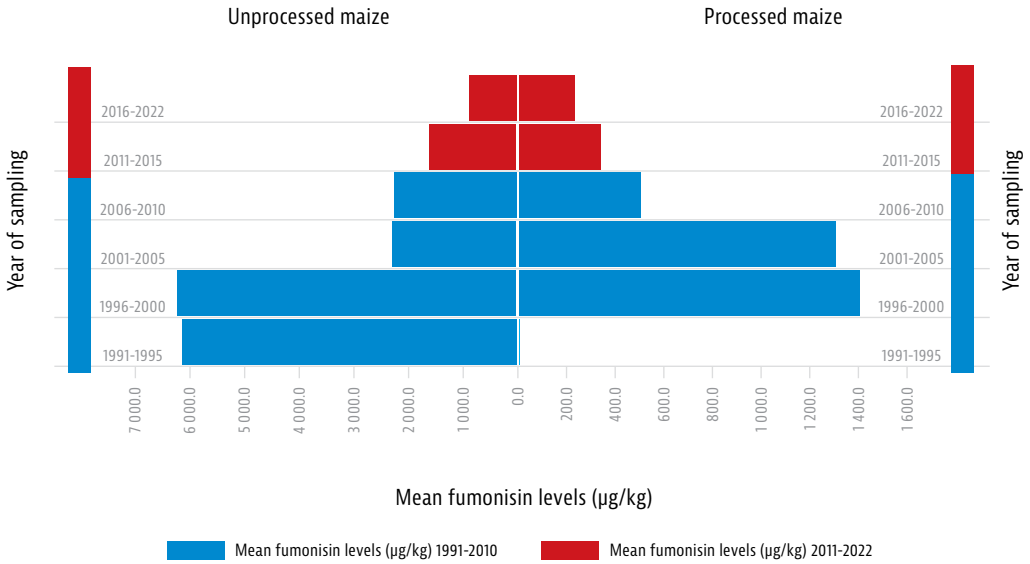
**Findings**: The CoP has had a transformative impact on Brazil's approach to managing mycotoxin contamination in cereals, markedly enhancing consumer health protection and domestic market safety.

**Analysis**: Before the establishment of the MLs, Brazil was facing challenges with both the import and export of maize, not being able to ensure its safety for consumers. Through participation in the CCCF, which provided a transparent and inclusive forum for discussing and addressing mycotoxin issues, ANVISA was able to set national MLs for specific mycotoxins and adapt the principles contained in the CoP for managing contamination across various commodities.

Although the initial proposed MLs were based on EU regulations, ANVISA later adjusted them, following extensive discussions with subcommittee members and stakeholders. Embracing a progressive strategy, ANVISA adopted relatively high MLs and followed a phased approach, gradually decreasing the acceptable levels each year. This innovative approach, combined with adopting GAP and GMP described in the CoP contributed to fumonisin reduction over time.

This strategic approach has yielded substantial improvements, as shown in **Figure 9** leading to a significant reduction in fumonisin levels in maize and maize–based products from 2000 to 2024, demonstrating the effectiveness of the implementation of the CoP and associated legislation in reducing mycotoxin contamination.

FIGURE 9 Mean fumonisin levels (µg/kg) in Brazilian unprocessed and processed maize across successive five–year periods, from 1991 to 2022 (UNICAMP).




Source: Rocha, L.O., Taniwak, M.H., Ennis, M., Lindner Schreiner, L.. and El Haffar, F. 2024. Reducing fumonisin contamination in Brazilian maize: The impact of Codex standards and regulatory frameworks. In: *Food Research International*, Vol. 197, Part 2. [Accessed on 2 April 2025]. https://doi.org/10.1016/j.foodres.2024.115280.

Additionally, research findings indicated a substantial decline in contamination levels since 2011, generally aligning with the Codex established MLs (**Table 1**).

TABLE 2 Probable daily intake (PDI) of fumonisins based on occurrence data reported in Brazil from 1991 to 2022. An average weight of 70 kg (men) and 60 kg (women) was considered and an average daily corn consumption of 18.1 g (men) and 15.2 g (women).[14]

| PDI (µg/kg of bw/day)[15] | | | | | | |
|---|---|---|---|---|---|---|
| **YEAR OF SAMPLING** | **1991–1995** | **1996–2000** | **2001–2005** | **2006–2010** | **2011–2015** | **2016–2022** |
| **Men** | 1.236 | 0.569 | 0.342 | 0.331 | 0.213 | 0.054 |
| **Women** | 1.211 | 0.557 | 0.335 | 0.324 | 0.209 | 0.053 |

Overall, implementation of the CoP and adaptation at national level, has not only contributed to reduced mycotoxin levels in maize but also reinforced Brazil's commitment to national food safety. MAPA and ANVISA have enhanced surveillance of mycotoxins in cereals, with increased testing at farms, processing facilities and market checkpoints. MAPA also conducted mandatory training for food inspectors, incorporating CoP guidance into national inspection protocols. EMBRAPA and ITAL have developed farmer training modules that teach small– and large–scale producers how to reduce mycotoxin risks through proper field and post–harvest practices. These national actions have led to food safety progress which is supported by various research studies that confirm a measurable decrease in mycotoxin contamination, ensuring a safer food supply and protecting consumer health.

14 Ongoing research – Prof Liliana Oliveira Rocha, Academia (UNICAMP) Campinas – SP.

15 PDI: probable daily intake; bw: body weight.

### 3.4.2 IMPACT ON ENSURING FAIR PRACTICES IN FOOD TRADE

**Findings**: The CoP has influenced Brazil's cereal production and trade practices, and the establishment of benchmarks that ensure both domestic and international compliance with food safety standards.

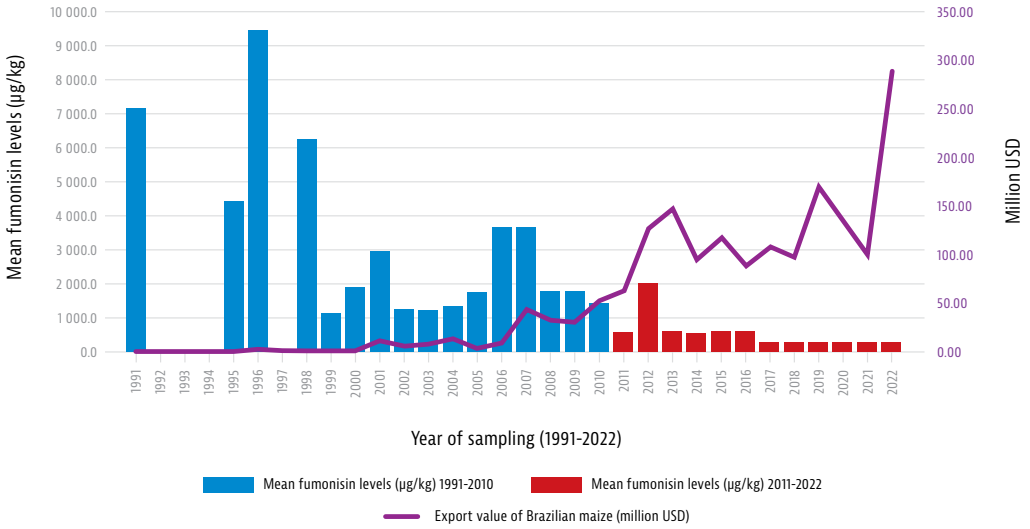
**Analysis**: Over the past decade, Brazil has significantly expanded its maize exports, ensuring its position as the world's second–largest exporter. This growth can be attributed to coordinated efforts, such as government investments and optimizing multiple crop seasons.[x]

The initiatives to reduce fumonisin contamination also played a significant role in this progress. For instance, research conducted by institutions such as EMBRAPA, Agronomical Institute of Campinas (IAC), and other research groups resulted in the development of new maize cultivars resistant to *Fusarium verticillioides* and fumonisin accumulation, thereby reducing contamination risks during pre–harvest.[xi]

Enhanced stakeholder awareness of GAP and GMP, along with the continuous efforts of MAPA to monitor mycotoxins in food and farmer compliance with the guidelines outlined in the CoP, further contributed to these advancements.

The collective impact of these measures has not only improved maize quality but also supported the overall boost in industry productivity. **Figure 10** shows an increased maize export value (USD) in Brazil and a reduction of fumonisin contamination based on published data during the last 30 years, emphasizing that while the export growth is due to various national factors, reducing fumonisin contamination in maize has not only enhanced product quality but also strengthened international market confidence and acceptance.[xii]

FIGURE 10 **Relationship between export value of Brazilian maize (US$) and fumonisin levels (µg/kg) from 1991 to 2022.**




Sources: Rocha, L.O., Taniwak, M.H., Ennis, M., Lindner Schreiner, L.. and El Haffar, F. 2024. Reducing fumonisin contamination in Brazilian maize: The impact of Codex standards and regulatory frameworks. In: *Food Research International*, Vol. 197, Part 2. [Accessed on 2 April 2025]. https://doi.org/10.1016/j.foodres.2024.115280 and FAO. 2025. FAOSTAT: Crops and livestock products. [Accessed on 2 April 2025]. https://www.fao.org/faostat/en/#data/QC Licence: CC-BY-4.0.

Stakeholders recognize that the establishment of MLs, supported by the CoP, underpinned by robust scientific practices and risk assessments, have been crucial in maintaining the quality of maize. This was fundamental for ensuring Brazil's competitiveness in the global market and increasing its exports.

# 4
# KEY LESSONS LEARNED AND RECOMMENDATIONS GOING FORWARD

## 4.1 KEY LESSONS LEARNED

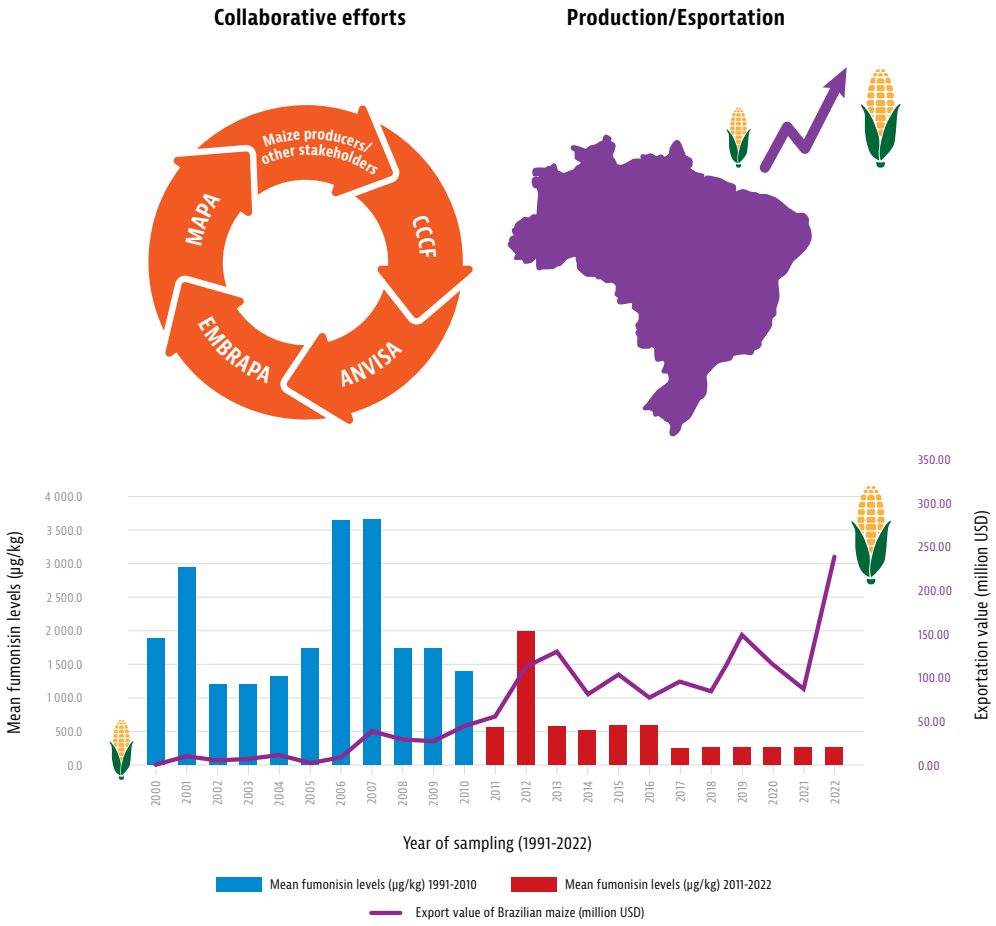
The findings of this case study lead to the conclusion that the CoP and the GAP and GMP contained in it, as adapted to the local context by Brazil, have played a fundamental role in implementing national MLs for fumonisin in maize and moving towards alignment with the Codex MLs for fumonisin in maize, which in return has enhanced food safety and helped increase production and export.

While the case study set out to look at the use and impact of the CoP, the findings indicate a more complex picture. It was impossible to consider the use and impact of the CoP without looking at the wider enabling environment and the interactions between various elements. These included the understanding gained through the JECFA evaluations on fumonisins, in particular on the role of data that is geographically representative and reflective of the implementation of good practices in different environments. The need to share that data with the international community through GEMS/Foods so that it can be taken into consideration in the development of Codex standards also became apparent. The establishment of MLs as a means of driving change which included implementation of the CoP was fundamental. Brazil's engagement in CCCF and the leading role they took there taking into consideration the national challenges they were facing was also important. Discussions on Codex MLs and the CoP at CCCF, informed national discussions in Brazil as well as vice versa such that they contributed to the development of Brazil's approach to establish MLs as a regulatory tool and use the CoP to support implementation of the regulation, while in parallel contributed to the evolution of Codex texts.

This highlights the important synergism that exists between MLs and CoPs, and while they are not always developed in parallel in Codex for various reasons, this study suggests that when it comes to implementation there is value in using both MLs and CoPs together to decrease mycotoxin contamination. However, for this to be effective there needs to be widespread stakeholder engagement and multiagency support. The efforts in Brazil were successful because of that extensive engagement which ensured that regulatory efforts were supported by research, awareness raising, training and updated inspection protocols, to name but a few. Time was also a critical factor. Brazil did not expect to make changes

overnight, rather the implementation of a progressive, phased approach, which allowed stakeholders to keep pace with a stepwise reduction in MLs helped ensure that producers and processors were not left behind. Figure 11 highlights the effectiveness of Brazil's participatory Codex approach, which involves key ministries and regulatory bodies such as ANVISA, MAPA, EMBRAPA and INMETRO, working closely with industry and other stakeholders to reduce national fumonisins levels and enhance export potential.

FIGURE 11 Graphical representation of Brazil's collaborative approach to addressing fumonisin levels and improving food safety and quality.




Sources: Rocha, L.O., Taniwak, M.H., Ennis, M., Lindner Schreiner, L.. and El Haffar, F. 2024. Reducing fumonisin contamination in Brazilian maize: The impact of Codex standards and regulatory frameworks. In: *Food Research International*, Vol. 197, Part 2. [Accessed on 2 April 2025]. https://doi.org/10.1016/j.foodres.2024.115280 and FAO. 2025. FAOSTAT: Crops and livestock products. [Accessed on 2 April 2025]. https://www.fao.org/faostat/en/#data/QC Licence: CC-BY-4.0.

These lessons learned may be valuable to other countries in their efforts to implement Codex standards. In addition to the above, some of the specific key success factors which drove the successful adoption and implementation of the CoP in Brazil are described below.

### 4.1.1 NATIONAL CODEX COMMITTEE STRUCTURE

The structure of Brazil's National Codex Committee, which mirrors that of the CAC, has proven essential in adopting Codex standards in line with national priorities. By involving a diverse range of stakeholders, including ministries, industry associations, consumer groups and academia, the committee ensures that the standards adopted are both scientifically sound and practically relevant.

The legal framework in Brazil, which mandates public consultations for new regulations, promotes transparency and fosters consensus–building among stakeholders. This inclusive approach facilitates the smooth adoption/adaptation of Codex texts while ensuring that local perspectives are taken into account, thereby strengthening food safety and regulatory measures at the national level.

### 4.1.2 ENGAGEMENT AND PARTICIPATION IN CODEX COMMITTEES

Brazil's active participation in Codex committees, including its leading role in chairing the EWG on the revision of the CoP, underscores the importance of having national representation in international standard–setting bodies. Through the Codex National Committee, involving key ministries such as agriculture and health, Brazil ensured that the GAP and GMP contained in the CoP were adapted to local agricultural practices and health priorities.

Public consultations on proposed MLs further promoted national ownership, allowing Brazil to balance international requirements with domestic realities. This engagement fosters an ongoing dialogue that enhances the relevance and applicability of Codex texts to the national context, ensuring smoother implementation and better alignment with local regulatory needs.

### 4.1.3 SUBMISSION OF OFFICIAL OCCURRENCE DATA

The submission of national occurrence data based on GAP and GMP is important to ensuring that the MLs established by CCCF for contaminants are representative of diverse regional conditions. Brazil's proactive approach to submitting data, particularly for mycotoxins in maize, highlights the importance of LMICs contributing to global databases to foster representation in international risk assessments. Building national capacity for data collection, including investment in laboratory infrastructure, is essential for accurate monitoring. Collaborative efforts with research organizations like EMBRAPA also increase the reliability and relevance of the data submitted, ensuring that Codex standards can be effectively implemented at the national level and contribute to improved food safety.

In addition, gaining industry's confidence by raising its awareness on the importance of submitting accurate and reliable data is also particularly important. Brazil was successful in advocating for this, by explaining the risk assessment process and sharing the lessons learned from the participation and engagement in CCCF.

### 4.1.4 ADOPTION OF MLS

Brazil's phased approach to adopting MLs for fumonisins in maize illustrates the benefits of gradual implementation. This strategy allows industry time to adjust and comply with new food safety regulations, ensuring a smooth transition to stricter safety requirements. Continuous regulatory review, informed by ongoing monitoring and scientific advancements, ensures that the national standards remain relevant and effective over time. This approach not only safeguards public health but also ensures that Brazil's agricultural products remain competitive in international markets.

### 4.1.5 NATIONAL COLLABORATION AND STAKEHOLDER ENGAGEMENT

Collaboration among Brazil's national ministries, regulatory bodies and industry stakeholders has been key to the successful dissemination and adaptation of the CoP. This cross–sectoral engagement ensures that food safety practices are aligned across different areas of the agricultural sector. However, while efforts are being made, there remains a significant gap between larger commercial producers and small–scale farmers in terms of awareness and application of the GAP and GMP of the CoP.

Targeted outreach and education programmes are necessary to bridge this gap, especially for smallholder farmers.

Additionally, translating the CoP into Portuguese and providing visually engaging, easy–to–understand content helps ensure that a wider audience, including non–technical stakeholders, can help implement best practices. Involving universities and research institutions in these efforts ensures that food safety principles are integrated into academic curricula, further strengthening the capacity of future generations to manage food safety risks effectively.

## 4.2 RECOMMENDATIONS

Based on the findings of this case study, to enhance the use and impact of the CoP across Brazil and globally, the following recommendations are proposed.

### 4.2.1 GOVERNMENT OF BRAZIL

#### Recommendation #1: Enhance accessibility and utilize diverse media for broader dissemination:

- **Adaptation and customization**: To address these aspects, the Brazilian National Codex Committee could further adapt the CoP to the local context. This initiative should not only include the core documents but also supplementary materials such as guidelines and advisory texts, ensuring they are culturally and contextually adapted to the local agricultural practices and needs. Ensuring availability in Portuguese would facilitate accessibility. Regional partners, such as PAHO and FAO, may be able to support such initiatives.
- **Multimedia approach**: Building on the efforts already made by EMBRAPA and ITAL, Brazilian government ministries could develop and deploy a range of visually–engaging educational materials such as infographics, videos and interactive webinars that can simplify complex scientific concepts and support the dissemination of the CoP. This approach should leverage popular social media platforms, television and radio to reach a broader audience.
- **Inclusion in academic curricula**: Brazilian academia could more systematically integrate the principles of the CoP into the curricula of agricultural, food science, and veterinary programmes across Brazilian universities and technical schools to educate the next generation of producers and industry regulators in mycotoxin management.

#### Recommendation #2: Develop targeted education and outreach for small producers:

- **Enhanced extension services**: Brazilian government ministries could work with partners, such as EMBRAPA and ITAL, to strengthen the role of agricultural extension services (e.g. hands–on workshops, field demonstrations and localized training sessions, etc.) to provide ongoing support and guidance to small–scale and rural producers, ensuring they have the necessary tools and knowledge to implement the principles of the CoP effectively.
- **Development of tailored training programmes**: Brazilian academia and other partners could implement specialized training sessions and workshops for small–scale and rural producers, and context–specific examples. These should focus on the practical aspects of mycotoxin management and be accessible via mobile platforms to reach remote areas.

### Recommendation #3: Implement regular monitoring and feedback mechanisms:

> **Strengthen monitoring system**: ANVISA and MAPA should reinforce their internal mechanisms to regularly assess the effectiveness of the implementation of the CoP GAP and GMP across different regions and sectors of Brazil. This system should gather feedback from all levels of stakeholders, particularly focusing on the grassroots level to tailor ongoing support and modifications to the relevant national regulation, derived from the CoP.

## 4.2.2 FAO, WHO AND THE CODEX ALIMENTARIUS COMMISSION

### Recommendation #4: Update CXC 51-2003:

> **Continuous improvement**: There was recognition that the sector continues to evolve in terms of practices and measures to reduce mycotoxin contamination, and thus the CCCF could consider initiating a review of the CoP to reflect the latest research, breadth of the production systems, and changing climatic conditions and agricultural practices.

> **Supporting materials**: Codex could consider adding to the CoP visually–engaging materials such as infographics, flowcharts, and figures that can simplify the understanding of the technical content of the CoP and make it more accessible to different stakeholders.

## 4.2.3 CODEX SECRETARIAT

### Recommendation #5: Incorporate lessons learned in the planning and development of future Codex case studies

> **Review the approach based on the experience of this case study**: A case study approach can be highly informative and allow a more in–depth analysis of how a Member might use one or more Codex texts. To get the most from the approach, adapting the performance measurement framework and tailoring of the interview questions to the context or perception of the context in which the questions are being asked could be considered. This could facilitate more precise and informative input from interviewees.

> **Maximize the benefits of in–person country missions**: In–person country missions offer unparalleled advantages for gathering insights, including the ability to observe industry practices first hand, access critical national documentation and optimize interviews with local stakeholders. To ensure a rich understanding of Codex text implementation at the national level, such missions should include mixed competencies covering both the M&E aspect and technical knowledge of the Codex text under review.

- **Engagement with national Codex counterparts**: Engaging a diverse range of stakeholders is essential for a comprehensive understanding of the use and impact of Codex texts. To streamline this process, future Codex case studies should work closely with government officials who are active in Codex work, as their involvement can help facilitate access to key stakeholders such as industry representatives, consumer groups and regulatory bodies. Leveraging the expertise and connections of these officials can significantly ease the complexities of stakeholder engagement and ensure that all relevant perspectives are captured.

# NOTES


i **United States Department of Agriculture Foreign Agricultural Service (USDA).** 2024. *Grain: World Markets and Trade.* https://fas.usda.gov/sites/default/files/2024-05/grain.pdf

ii **Allen, E., & Valdes, C.** 2023. *Brazil's Corn Industry and the Effect on the Seasonal Pattern of U.S. Corn Exports.* www.ers.usda.gov

iii **Gevásio.** 2021; Sologuren. 2015. 2024.*Boletim do monitoramento agrícola, cultivos de verão e inverno*, 5º levantamento safra 2023/2024.

iv **Mattos, F. L., & da Silveira, R. L. F.** 2024. The expansion of the Brazilian winter corn crop and its impact on price transmission. *International Journal of Financial Studies*, 6, Article 45. https://doi.org/10.3390/ijfs6020045

v **Sydenham, E. W., Marasas, W. F. 0, Shephard, G. S., Thiel, P. G., & Hirooka, E. Y.** 1992. Fumonisin Concentrations in Brazilian Feeds Associated with Field Outbreaks of Confirmed and Suspected Animal Mycotoxicoses. *Journal of Agriculture and Food Chemistry*, 40, 994–997.

vi **FAO & WHO.** 1995. *General standard for contaminants and toxins in food and feed. Codex Alimentarius Standard*, No. CXS 193-1995. Codex Alimentarius Commission. Rome. https://www.fao.org/fao-who-codexalimentarius/sh-proxy/fr/?lnk=1&url=https%253A%252F%252Fworkspace.fao.org%252Fsites%252Fcodex%252FStandards%252FCXS%2B193-1995%252FCXS_193e.pdf

vii **Dos Santos Lopes, L., Ramos, G. L.P.A., Alvarenga, V. O., Campagnollo, F. B., Oliveira; Syllas B.S.,Freire, L. & Anderson S. Sant'Ana.** 2023. *Quantitative risk assessment of the presence of fumonisin in corn produced in different regions of Brazil: Influence of climatic conditions*, Environmental Research, Vol. 237, No. 116907: pp. 1–9.

viii **FAO & WHO.** 2018. *Framework for the Provision of Scientific Advice on Food Safety and Nutrition, Food and Agriculture Organization of the United Nations*, Rome/Geneva. https://www.infoteca.cnptia.embrapa.br/infoteca/bitstream/doc/1156825/1/Selecao-de-genotipos-de-milho-tropical-com-menor-incidencia-de-fumonisinas.pdf

ix **Brazilian Agricultural Research Corporation (EMBRAPA).** 2023. *Circular Técnica 284, EMBRAPA Maize & Sorghum*.

x **Companhia Nacional de Abastecimento. Acompanhamento da safra brasileira** 2020/2021, 11º levantamento. https://static.poder360.com.br/2021/08/ConabBoletimSafra11levantamento.pdf

xi **de Almeida, R. N., Vivas, M., Ribeiro, N. M. O., Saluci, J. C. G., Valadares, F. V., Vasconcelos, L. C., & do Amaral Júnior, A. T.** 2023. *Fusarium ear rot resistance in South American popcorn lines.* Tropical Plant Pathology, 48(6), 656–666. https://doi.org/10.1007/s40858-023-00607-3

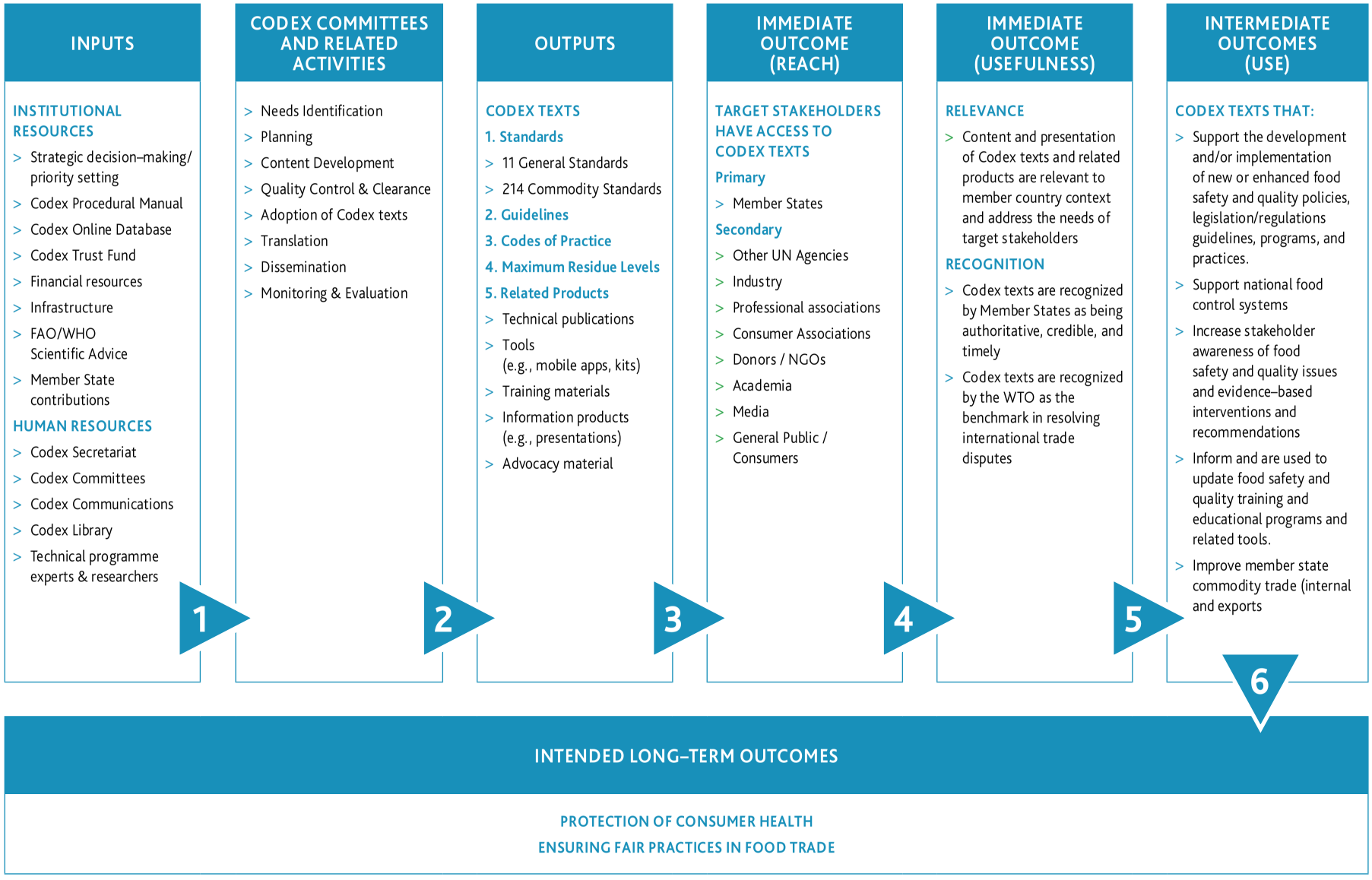
xii **Costa, R., Cota, L., Rocha, L., Nolasco, A., Da Silva, D., Pereira, D., & Ferreira, P.** 2010. *Recomendação de Cultivares deMilho para a Resistência a Grãos Ardidos*. EMBRAPA.

# ANNEX A
# ALIGNMENT WITH CODEX M&E FRAMEWORK FOR USE AND IMPACT OF CODEX TEXTS

The 42nd Session of the Codex Alimentarius Commission (CAC42) adopted the *Codex Strategic Plan 2020–2025* as proposed by the 77th Session of the Executive Committee of the Codex Alimentarius Commission (CCEXEC77). Goal 3 "Increase impact through the recognition and use of Codex standards" has three objectives, of which objective 3.3 "Recognize and promote the impact of Codex standards" includes as an outcome "Having a mechanism/tool to measure the impact of Codex standards developed and piloted".

The Secretariat, in collaboration with FAO and WHO evaluation offices, developed a mechanism to measure the use and impact of Codex standards in 2021. A monitoring and evaluation (M&E) framework to provide data about the use and impact of Codex texts was developed with a view to obtaining information that can help Members and Observers better understand the impact, or potential for impact, of Codex texts. The theory of change for the Codex M&E framework is summarized in the figure below and identifies five broad measurement areas (i.e. outputs, reach, usefulness, use and contribution to intended long–term outcomes) that serve as the basis of performance planning, monitoring and reporting.

FIGURE A1 Codex M&E framework theory of change.



In 2022 and 2023, the development of the mechanism focused on data gathering and analysis from two sources: 1) Codex Survey 2022 and Codex Survey 2023 and 2) the piloting of a case study approach with a focus that includes the identification of potential best practices in the use and impact of a specific Codex text(s).

**Table A1** lists the indicators that will be addressed by the case study as identified in the performance measurement framework for the use and impact of Codex texts. These performance indicators will form the basis of the case study analysis.

TABLE A1 **Indicators identified in the performance measurement framework for the use and impact of Codex texts to be addressed by the case study.**

| OUTCOMES | INDICATORS | METHOD |
|---|---|---|
| **A) IMMEDIATE OUTCOMES** | | |
| **Immediate outcome – reach**<br>Target stakeholders have access to *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003).<br>◆ Primary stakeholders (i.e. national competent authority) | **Intended reach**<br>◆ Stakeholders' perceptions regarding the appropriate and sufficient dissemination of CXC 51–2003 | Interviews |
| | **Distribution**<br>◆ Number of copies/links of CXC 51–2003 (especially in national standards or regulations)<br>◆ Number of file downloads by stakeholders | Document review<br>Data analysis |
| | **Language**<br>◆ Stakeholder and CAC perceptions of the extent to which CAC dissemination strategies, policies and plans target different language audiences for CXC 51–2003<br>◆ Reach information of CXC 51–2003<br>◆ By UN language group | Interviews<br>Document review |
| **Immediate outcome – usefulness (relevance)**<br>Content and presentation of CXC 51–2003 and related products are relevant to Brazil's context and address the needs of target stakeholders | **Stakeholder priorities**<br>◆ Extent to which Brazil's priority food safety and quality needs are met | Interviews<br>Document review |
| | **Stakeholder satisfaction**<br>◆ Degree of satisfaction with CXC 51–2003 (need, quality)<br>◆ Degree of satisfaction by stakeholders who rate the content of CXC 51–2003 as useful. | Interviews |
| **Immediate outcome – usefulness (recognition)**<br>CXC 51–2003 is recognized by Brazil as being authoritative, credible and timely | **Authoritative**<br>◆ Stakeholders' perceptions of CXC 51–2003 versus others (e.g. industry standards, etc.) | Interviews |
| | **Credible**<br>◆ Stakeholder's opinion of quality and credibility of CXC 51–2003 | Interviews |

TABLE A1 Indicators identified in the performance measurement framework for the use and impact of Codex texts to be addressed by the case study. (cont.)

| OUTCOMES | INDICATORS | METHOD |
|---|---|---|
| **B) INTERMEDIATE OUTCOME** | | |
| **Intermediate outcome – use**<br>1. CXC 51–2003 supports the development and/or implementation of new or enhanced food safety and quality policies, legislation/regulations guidelines, programmes and practices | ◆ The number of newly developed national policies, regulations, programmes and practices that use CXC 51–2003 as a baseline<br>◆ The adoption or use of CXC 51–2003 by Brazil as demonstrated by data collection/surveys that show whether the use of CXC 51–2003 helped decrease mycotoxin levels | Interviews<br>Document review |
| **Intermediate outcome – use**<br>2. CXC 51–2003 increases stakeholder awareness of food safety and quality issues and evidence–based interventions and recommendations | ◆ Level of stakeholder awareness of CXC 51–2003 (e.g. # of information demands, surveys, website hits, # of education interventions, etc.)<br>◆ Level of industry adoption of CXC 51–2003 | Interviews<br>Document review |
| **Intermediate outcome – use**<br>3. CXC 51–2003 informs and is used to update food safety and quality training and educational programmes and related tools | ◆ Degree of satisfaction by stakeholders who report knowledge gained from CXC 51–2003 | Interviews |
| **Intermediate outcome – use**<br>4. CXC 51–2003 improves Brazil's commodity trade (internal and exports) | ◆ Brazil has the capacity to measure/confirm compliance data for MLs in support of Brazil's commodity trade | Interviews<br>Document review |
| **C) INTENDED LONG–TERM OUTCOMES** | | |
| Protection of consumer health | ◆ Extent to which the adoption of CXC 51–2003 in Brazil has had an impact on foodborne illness | Interviews<br>Document review |
| Ensuring fair practices in food trade | ◆ Number of market access agreements negotiated/in progress that are supported by CXC 51–2003<br>◆ Number of international, regional, or bilateral agreements signed/under negotiation that are supported by CXC 51–2003 | Interviews<br>Document review |

# ANNEX B
# DOCUMENT LISTING

For a comprehensive case study on the impact of *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) on the reduction of fumonisins levels in maize in Brazil, a variety of document categories should be reviewed to provide insights into the implementation, effectiveness, and outcomes of CXC 51–2003 within Brazil's agricultural and food safety frameworks.

TABLE A2 **Breakdown of the case study document categories and identified documents.**

| CATEGORY | DESCRIPTION | DOCUMENTS |
|---|---|---|
| **1. Codex texts** | The Codex text itself and other related Codex standards and guidelines and Codex meeting reports that might influence cereal safety and quality. | 1. *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003)<br>2. CCCF 7 Session (February 2013)<br>a. CF07_17e: Discussion paper on fumonisins in maize and maize products: Code of practice and any other measures to control fumonisins in maize<br>b. CF07_18e: Discussion paper on aflatoxins in cereals<br>3. CCCF 8 Session (February 2014)<br>a. CF08_09e: Proposed draft maximum levels (MLs) for fumonisins in maize and maize products and associated sampling plans (prepared by Brazil)<br>b. CF08_14e: Discussion paper on the possible revision of the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CAC/RCP 51–2003)<br>c. CF08_15e: Discussion paper on aflatoxins in cereals<br>4. CCCF 9 Session (December 2014)<br>a. CF09_10e: Proposed draft revision of the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CAC/RCP 51–2003)<br>5. CCCF 10 Session (February 2016)<br>a. CF10_11e: Proposed draft annexes to the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CAC/RCP 51–2003)<br>6. CCCF 13 Session (March 2019)<br>a. CF13_15e: Discussion paper on the establishment of MLs for total aflatoxins in cereals (wheat, maize, sorghum and rice), flour and cereal–based foods for infants and young children<br>7. CCCF 14 Session (March 2021)<br>a. CF14_10e: Maximum levels for total aflatoxins in certain cereals and cereal–based products including foods for infants and young children<br>8. CCCF 15 Session (March 2022)<br>a. CF15_09e: Maximum levels for total aflatoxins in certain cereals and cereal–based products including foods for infants and young children and associated sampling plans<br>9. CCCF 16 Session (February 2023)<br>a. CF16_07e: Sampling plans for total aflatoxins in certain cereals and cereal–based products including foods for infants and young children |

TABLE A2 Breakdown of the case study document categories and identified documents. (cont.)

| CATEGORY | DESCRIPTION | DOCUMENTS |
|---|---|---|
| **2. Brazilian regulatory documents** | National regulations and guidelines on cereal safety that reference or incorporate CXC 51–2003.<br>Could include official statements or documents from Brazilian agricultural and food safety authorities (e.g. Ministry of Agriculture, Livestock and Food Supply; ANVISA) on the adoption and implementation of CXC 51–2003 or other related Codex standards and guidelines. | 10. Resolução – RDC No 07, De Fevereiro de 2011(*) DOU de 09/03/2011 Dispõe sobre limites máximos toerados (LMT) para micotoxinas em alimentos<br>11. Instrução Normativa – IN Nº 160, de 1º de julho de 2022 (Publicada no DOU nº 126, de 6 de julho de 2022)<br>12. Comitê Codex Alimentarius Do Brasil, Regimento Interno, Rev.5 |
| **3. Scientific and technical research** | Studies and research articles on the levels of fumonisins in maize in Brazil before and after the implementation of CXC 51–2003.<br>Could include research on the effectiveness of specific practices recommended by Codex for reducing mycotoxin levels in cereals. | 13. *Understanding mycotoxin contamination across the food chain in Brazil: Challenges and opportunities*<br>14. *Analysis of fumonisins versus exports for Brazil, University of Campinas* |
| **4. International best practices** | Comparative studies examining the effectiveness of the CXC 51–2003. implementation in Brazil and other countries.<br>Could include lessons learned and best practices from other countries that could inform further improvements in Brazil. | 15. *Fungal diversity and metabolomic profiles in GM and isogenic non–GM maize cultivars from Brazil*, Mycotoxin Research (2021) 37:39–48, A. M. Gasperini, E. Garcia–Cela, M. Sulyok, A. Medina, and N. Magan<br>16. *Understanding fungi contamination across the food chain in Brazil: Challenges and opportunities*, Marta H. Taniwaki, John I. Pitt, Marina V. Copetti, Aldir A. Teixeira, Beatriz T. Iamanaka<br>17. *Mycotoxins in Cattle Feed and Feed Ingredients in Brazil: A Five–Year Survey, Toxins*, Gabriela L. Biscoto, Lauranne A. Salvato, Érika R. Alvarenga, Raul R. S. Dias, Guilherme R. G. Pinheiro, Mariana P. Rodrigues, Priscila N. Pinto, Rossimiriam P. Freitas and Kelly M. Keller<br>18. *Quantitative risk assessment of the presence of fumonisin in corn produced in different regions of Brazil: Influence of climatic conditions*, Environmental Research, Letícia dos Santos Lopes, Gustavo L.P.A. Ramos, Veronica O. Alvarenga, Fernanda B. Campagnollo, Syllas B.S. Oliveira, Luisa Freire, Anderson S. Sant'Ana |
| **5. Implementation reports** | Reports from government agencies or independent bodies assessing the implementation of CXC 51–2003 within Brazil.<br>Could include evaluations of compliance levels among maize producers and processors. | 19. *Follow–Up of the Brazilian Crop Grains*, Harvest 2023/24, 5th Survey, Copyright © 2023– Companhia Nacional De Abastecimento<br>20. *Brazil's Maize Exports (2013–2023)* Source: AGROSTAT – Brazilian agribusiness foreign trade statistics<br>21. *Supply and Demand Balance Brazil Maize (2013/14 to 2023/24)* Source: FAO–AMIS (Distributed by AMIS Statistics)<br>22. Fumonisins data final (2020–2023) + graphs<br>23. *CENSO Agropecuário 2017*, Instituto Brasileiro De Geografia E Estatística – IBGE, Ministério da Economia |

TABLE A2 Breakdown of the case study document categories and identified documents. (cont.)

| CATEGORY | DESCRIPTION | DOCUMENTS |
|---|---|---|
| **6. Agricultural and food safety practices** | Documentation of changes in agricultural practices among maize producers in response to CXC 51–2003. Could include case studies or reports on the adoption of best practices for mycotoxin reduction in the cereal production chain. | 24. *Brazil is the world's fourth largest grain producer and top beef exporter*, Socioeconomic and environmental studies, EMBRAPA |
| **7. Impact assessments and reviews** | Impact assessment studies evaluating the health, economic and agricultural impacts of reduced fumonisins levels in maize. Could include reviews or meta analyses summarizing findings from multiple studies on the topic. | 25. *Fungal diversity and metabolomic profiles in GM and isogenic non–GM maize cultivars from Brazil*, Mycotoxin Research (2021) 37:39–48, A. M. Gasperini, E. Garcia–Cela, M. Sulyok, A. Medina, and N. Magan<br>26. *Understanding Fungi Contamination Across the Food Chain in Brazil: Challenges and Opportunities*, Marta H. Taniwaki, John I. Pitt, Marina V. Copetti, Aldir A. Teixeira, Beatriz T. Iamanaka<br>27. *Mycotoxins in Cattle Feed and Feed Ingredients in Brazil: A Five–Year Survey, Toxins*, Gabriela L. Biscoto, Lauranne A. Salvato, Érika R. Alvarenga, Raul R. S. Dias, Guilherme R. G. Pinheiro, Mariana P. Rodrigues, Priscila N. Pinto, Rossimiriam P. Freitas and Kelly M. Keller<br>28. Quantitative risk assessment of the presence of fumonisin in corn produced in different regions of Brazil: Influence of climatic conditions, Environmental Research, Letícia dos Santos Lopes, Gustavo L.P.A. Ramos, Veronica O. Alvarenga, Fernanda B. Campagnollo, Syllas B.S. Oliveira, Luisa Freire, Anderson S. Sant'Ana |
| **8. Stakeholder feedback** | Surveys, interviews or testimonials from farmers, agronomists, food safety experts and industry representatives on the challenges and successes in implementing CXC 51–2003. Could include consumer safety and awareness campaigns related to mycotoxin risks and prevention. | |

# ANNEX C
# STAKEHOLDER INTERVIEWS

In–depth interviews and focus group discussions were conducted with key stakeholders, including government officials, agricultural experts, producers, industry representatives and research institutions. Interviews were conducted in–person during the country mission and also via videoconference, both before and after the country mission. In–person interviews were also supported by on–site visits to maize production and processing facilities to both conduct the interview and observe practices.

TABLE A3 The targeted number of interviews for the case study.

| STAKEHOLDER | INTERVIEW GUIDE | NUMBER OF INTERVIEWS |
|---|---|---|
| Strategic interviews | S1 | 2–3 |
| Codex Secretariat | G1 | 2–3 |
| Brazil: Ministry of Health, Codex contact point, etc. | G2 | 6–8 |
| Brazil: industry, professional associations, consumer associations, etc. | G3 | 4–6 |
| FAO/WHO country offices – Codex leads | G4 | 2–3 |
| Other stakeholders | | |
| ◆ Donor partners | G5 | 1–2 |
| ◆ Research/academia | G5 | 1–2 |
| **Total** | | **16–27** |

## TABLE A4 Detailed information for interviewees.

| INSTITUTION | NAME |
|---|---|
| **INTERVIEW GUIDE #G2: BRAZIL MEMBER STATE (MINISTRY OF HEALTH, CODEX CONTACT POINT, ETC.) (n= 4–6)** | |
| **ANVISA** | Ligia Schreiner – Food Evaluation and Effectiveness Manager (**case study interview**)<br>Patrícia Castilho – General Food Manager.<br>Patrícia Tagliari – Deputy Director of the Medicine and Food Department at ANVISA. |
| **INMETRO** | Paulo Silva – Deputy Head of International Affairs or Coordinator of the Brazilian Codex Committee (**case study interview**)<br>Jorge Antonio da Paz Cruz – Head of International Affairs.<br>Fabiano Gonzaga – Deputy head of the Chemical Metrology Division.<br>Fernando Volante – Technologist researcher<br>Rodrigo Vivarelli – Technologist researcher<br>Marcelo Dominguez – Technologist researcher |
| **Ministry of Foreign Affairs (MRE)** | Luiz Fellipe F. Schmidt – Head of the Agricultural Policy Division<br>Igor Moraes – Second Secretary of the Agricultural Policy Division (**case study interview**) |
| **Ministry of Agriculture and Livestock (MAPA)** | Rafael Barrocas – Federal Agricultural Tax Auditor (SDA) (**case study interview**)<br>Eugenia Azevedo Vargas – Coordination of Laboratory Demands (**case study interview**)<br>Guilherme Antonio da Costa Júnior – Chief of Cabinet of Commerce and International Relations (**case study interview**) |
| **INTERVIEW GUIDE #G3: BRAZIL NON–STATE ACTORS (INDUSTRY, PROFESSIONAL ASSOCIATIONS, CONSUMER ASSOCIATIONS, ETC. [n= 4–6])** | |
| **ABIA** | Melina Karacristo – Regulatory Affairs Specialist at ABIA (Brazilian Food Industry Association) (**case study interview**) |
| **Cargill** | Renata Cerqueira – Global Food Safety Risk Management Lead (**case study interview**)<br>Chantal Gabardo – Food Safety, Quality and Regulatory (FSQR) Risk Assessor (**case study interview**) |
| **CoopaDF** | Alan Cenci, rural producer (**case study interview**) |
| **ABRAMILHO** | Glauber Silveira – Executive Director of Abramilho. (**case study interview**)<br>Enori Barbieri – Vice–President. (**case study interview**)<br>Daniel Rosa, Technical Director. (**case study interview**) |
| **INTERVIEW GUIDE #G4: FAO/WHO REGIONAL OFFICES – CODEX LEADS (n= 2–3)** | |
| **PANAFTOSA** | André Luis de Sousa dos Santos – Food Safety and Surveillance Adviser (**case study interview**)<br>Rosana Silva – Food Safety Assistant<br>Marcos Cunha – Food Safety and Antimicrobial Resistance Consultant |
| **FAO Brazil** | Jorge Meza – FAO Representative<br>Gustavo Chianca – FAO Representative Assistant for Programme |
| **INTERVIEW GUIDE #G5: OTHER STAKEHOLDERS (DONOR PARTNERS, RESEARCH/ACADEMIA, ETC. [n= 2–4])** | |
| **EMBRAPA** | Edna Maria Morais Oliveira – General Head of EMBRAPA Food Agroindustry<br>Marco Aurélio Guerra Pimentel – Researcher at EMBRAPA maize and sorghum (**case study interview**)<br>Humberto Ribeiro Bizzo, Essential Oils and Gas Chromatography Researcher<br>Izabela Miranda – Researcher in Waste and Contaminants<br>André Dutra, Chefe Adjunto de Transferência de Tecnologia |
| **ITAL** | Marta Hiromi Taniwaki – Fungi researcher at the Institute of Food Technology (ITAL) (**case study interview**) |
| **UnB** | Patrícia Diniz Andrade – Professor at University of Brasília's Faculty of Agronomy and Veterinary Medicine. (**case study interview**) |
| **UNICAMP** | Liliana de Oliveira Rocha – Professor and postgraduate coordinator at UNICAMP's Faculty of Food Engineering (**case study interview**) |

# ANNEX D
# INTERVIEW GUIDES

These questions were asked of internal and external stakeholders. The phrasing of the questions varied depending on the audience and was reflected in the individual interview guides.

## INTRODUCTION

The Secretariat of the Codex Alimentarius Commission (CAC) commissioned a case study to support the implementation of a monitoring framework to measure the use and impact of Codex texts. This case study will focus on the use and impact of a specific Codex text: Code of practice for the prevention and reduction of mycotoxin contamination in cereals (CXC 51–2003) in Brazil, a global leader in maize production.

This interview is part of the case study process to assess the adaptation and use of Codex text CXC 51–2003 in Brazil. You have been identified as a valuable resource to provide input to this process. The following questions will serve as a guide for our interview. Your responses should be provided in the context of the implementation of Codex texts in Brazil. Please provide concrete examples whenever possible.

Please be assured that your responses will be managed with discretion and the information gathered from these interviews will be reported at the aggregate level, and individual responses will not be attributed to you in the final case study report. We request your permission to record the interview but will not do so if you have any objections. The recording of interviews is to ensure we have captured all your comments correctly. The password–protected audio files are kept only by the case study, are never shared with CAC, and are destroyed after transcription.

The interview will take approximately 60 minutes to complete.

TABLE A5 The proposed interview questions and interview guides.

| REF # | QUESTION | INTERVIEW GUIDE G1: CODEX SECRETARIAT | INTERVIEW GUIDE G2: BRAZILIAN MINISTRIES | INTERVIEW GUIDE G3: BRAZIL: INDUSTRY, ETC. | INTERVIEW GUIDE G4: FAO/ WHO COUNTRY OFFICES | INTERVIEW GUIDE G5: OTHER STAKEHOLDERS |
|---|---|---|---|---|---|---|
| **CRITERIA 1: REACH (IMMEDIATE OUTCOME)** | | | | | | |
| **1.1** | **What is the extent to which the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) reaches its intended stakeholders in Brazil?** | **4** | **4** | **2** | **4** | **2** |
| 1.1.1 | How does Codex Alimentarius Commission (CAC) target key ministries in Member States? To what extent do CAC policies, strategies, plans, and/or procedures support the dissemination and adaptation of the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003)? | x | x | | x | |
| 1.1.2 | To what extent is the intended reach in Brazil achieved? Is the dissemination of the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) sufficient and appropriate? | x | x | x | x | x |
| 1.1.3 | How does CAC target different national/regional language audiences? To what extent does CAC dissemination strategies, policies and plans for the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) target different language audiences in Brazil and/or the region? | x | x | | x | |
| 1.1.4 | How does media approach (e.g. web only, print, etc.) for the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) affect reach? What media should be used to increase reach? | x | x | x | x | x |
| **1.2** | **What is the extent to which the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) reaches its intended stakeholders?** | **1** | **1** | **1** | **1** | **1** |
| 1.2.1 | For the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003), what gaps, if any, exist in the engagement of targeted primary stakeholders (i.e. Member States)? Secondary stakeholders (i.e. other UN Agencies, industry, professional associations, consumer associations, donors/NGOs, academia, media, General public/consumers)? | x | x | x | x | x |

TABLE A5 The proposed interview questions and interview guides. (cont.)

| REF # | QUESTION | INTERVIEW GUIDE G1: CODEX SECRETARIAT | INTERVIEW GUIDE G2: BRAZILIAN MINISTRIES | INTERVIEW GUIDE G3: BRAZIL: INDUSTRY, ETC. | INTERVIEW GUIDE G4: FAO/ WHO COUNTRY OFFICES | INTERVIEW GUIDE G5: OTHER STAKEHOLDERS |
|---|---|---|---|---|---|---|
| **CRITERIA 2: USEFULNESS (IMMEDIATE OUTCOME)** | | | | | | |
| **2.1** | **What is the perceived usefulness of the Code of practice for the prevention and reduction of mycotoxin contamination in cereals (CXC 51–2003)?** | **3** | **5** | **5** | **5** | **4** |
| 2.1.1 | How well does the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) respond to Brazil's strategies and priorities related to protection of consumer health and to ensuring fair practices in food trade? | | x | x | x | x |
| 2.1.2 | To what extent is the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) based on needs? Is it addressing priority needs? | x | x | x | x | |
| 2.1.3 | To what extent are Brazil's stakeholders satisfied with the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003), in terms of<br>◆ usefulness of content?<br>◆ new knowledge gained?<br>◆ informing country policies or advocacy?<br>◆ enhancing country programmes, training/education, or research? | | x | x | x | x |
| 2.1.4 | To what extent does the format, language and dissemination of the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) affect perceptions of its usefulness? Is the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) usable in terms of plain language, format, support, etc.? | x | x | x | x | x |
| 2.1.5 | To what degree is the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) recognized as being:<br>◆ Authoritative (i.e. perceptions of CXC 51–2003 versus others, such as industry standards)<br>◆ Credible (i.e. opinion of quality and credibility of the text)<br>◆ Timely (i.e. opinion on the timeliness of the development and implementation of CXC 51–2003)?<br>What shortcomings exist, if any? | x | x | x | x | x |

TABLE A5 The proposed interview questions and interview guides. (cont.)

| REF # | QUESTION | INTERVIEW GUIDE G1: CODEX SECRETARIAT | INTERVIEW GUIDE G2: BRAZILIAN MINISTRIES | INTERVIEW GUIDE G3: BRAZIL: INDUSTRY, ETC. | INTERVIEW GUIDE G4: FAO/ WHO COUNTRY OFFICES | INTERVIEW GUIDE G5: OTHER STAKEHOLDERS |
|---|---|---|---|---|---|---|
| **CRITERIA 3: USE (INTERMEDIATE OUTCOME)** | | | | | | |
| **3.1** | **What is the extent to which the Code of practice for the prevention and reduction of mycotoxin contamination in cereals (CXC 51–2003) is used as references and as the authoritative sources for decision–making in food production contexts?** | **1** | **6** | **6** | **6** | **6** |
| 3.1.1 | To what extent has the adoption of CXC 51–2003 supported the development and/or implementation of new or enhanced food safety and quality policies, legislation/regulations guidelines, programmes and practices in Brazil? | | x | x | x | x |
| 3.1.2 | To what extent has the adoption of CXC 51–2003 supported the national food control system of Brazil? Has the Brazilian food control system become more harmonized as a result of CXC 51–2003 application? | | x | x | x | x |
| 3.1.3 | To what extent has the adoption of CXC 51–2003 increased stakeholder awareness of food safety and quality issues and evidence–based interventions and recommendations in Brazil? What is the level of industry adoption of CXC 51–2003? | | x | x | x | x |
| 3.1.4 | To what extent has the adoption of CXC 51–2003 informed and been used to update food safety and quality training and educational programmes and related tools in Brazil? | | x | x | x | x |
| 3.1.5 | To what extent has the adoption of CXC 51–2003 improved Brazil's commodity trade (internal and exports)? Is there available data that can support trade impact findings (e.g. trends in trade volume and value, compliance and rejection rates, costs related to trade, etc.) | | x | x | x | x |
| 3.1.6 | How can CAC and Brazil foster the better use of CXC 51-2003? What are Brazil's information needs and preferred dissemination methods and guideline tools? | x | x | x | x | x |

TABLE A5 The proposed interview questions and interview guides. (cont.)

| REF # | QUESTION | INTERVIEW GUIDE G1: CODEX SECRETARIAT | INTERVIEW GUIDE G2: BRAZILIAN MINISTRIES | INTERVIEW GUIDE G3: BRAZIL: INDUSTRY, ETC. | INTERVIEW GUIDE G4: FAO/ WHO COUNTRY OFFICES | INTERVIEW GUIDE G5: OTHER STAKEHOLDERS |
|---|---|---|---|---|---|---|
| **CRITERIA 4: INTENDED LONG–TERM OUTCOME** | | | | | | |
| **4.1** | **Extent to which Intended long–term outcomes at the Brazilian individual, state and national levels are improved?** | **0** | **1** | **1** | **1** | **1** |
| 4.1.1 | To what extent have the adoption of the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) have had an impact on:<br>◆ Protection of consumer health?<br>◆ Ensuring fair practices in food trade? | | x | x | x | x |
| **CRITERIA 5: LESSONS LEARNED** | | | | | | |
| **5.1** | **What are the lessons learned from dissemination and knowledge translation processes for the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003) at various levels? (state, country, region, global)** | **3** | **3** | **3** | **2** | **2** |
| 5.1.1 | Which enabling factors have influenced the adaptation and use of the *Code of practice for the prevention and reduction of mycotoxin contamination in cereals* (CXC 51–2003)? | x | x | x | | |
| 5.1.2 | What have been the lessons learned, positive and negative? | x | x | x | x | x |
| 5.1.3 | What are the areas for improvement? | x | x | x | x | x |

# ANNEX E
# COUNTRY MISSION ITINERARY

## BRAZIL (March 20 to March 30, 2024)

A ten–day country mission to Brazil will aid the collection of relevant documentation and facilitate the conduct of interviews and focus groups for the Contaminants in Maize Case Study. The programme for the case study team consists of the following, although exact details will continue to evolve dependent upon stakeholder availability.

TABLE A6 **Brazil mission itinerary.**

| DAY | DATE | ACTIVITY |
|---|---|---|
| Wednesday | 20 March 2024 | Arrival in Campinas – Farid, Michael and Aline meet with Ligia Schreiner, Paulo Silva and Stefan Schrimer |
| Thursday | 21 March 2024 | Morning |
| | | 09.00 Meeting with Food Technology Institute (ITAL) |
| | | 10.30 Meeting with Associação Brasileira da Indústria de Alimentos (ABIA) |
| | | 12.00 Meeting with Academia Representative (UNICAMP) |
| | | Lunch with ITAL Director |
| | | Afternoon |
| | | Transfer Campinas – Curitiba by plane |
| Friday | 22 March 2024 | Car to Castro (2hours) – visit Cargill for Maize processing – Back to Curitiba |
| Saturday | 23 March 2024 | Transfer Curitiba – Brasilia (05:35) |
| | | Visit to Coopadf – Organized by FAO Representation |
| Monday | 25March 2024 | Morning |
| | | 10.00 Meeting with FAO Representation |
| | | 11.30 Meeting with Ministry of External Relations, Agricultural Policy division (DPAGRO) |
| | | Afternoon |
| | | 14.00 Meeting with Ministry of Agriculture, ABRAMILHO |
| | | 16.30 Meeting with Ministry of Agriculture (Chief Cabinet Secretariat External Affairs) |
| Tuesday | 26 March 2024 | Morning |
| | | 09.00 Meeting with Brazilian Health Regulatory Agency (ANVISA) |
| | | 11.30 Meeting with national group responsible to discuss Codex issues related to contaminants – academia |
| | | Afternoon |
| | | Transfer Brasilia – Rio |
| Wednesday | 27 March 2024 | Morning |
| | | 09.00 Meeting with Brazilian National Institute of Metrology, Standardization, and Industrial Quality (INMETRO) Visit to the chemistry metrology division |
| | | Afternoon |
| | | 09.00 Meeting with PANAFTOSA PAHO–WHO |
| Thursday | 28 March 2024 | 09.00 Meeting with EMBRAPA Food Industry |
| Friday | 29 March 2024 | Mission debrief |
| Saturday | 30 March 2024 | Departure from Rio |

Ministry of Food and Drug Safety
Republic of Korea

For further information on the activities
of the Codex Alimentarius Commission, please contact:
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